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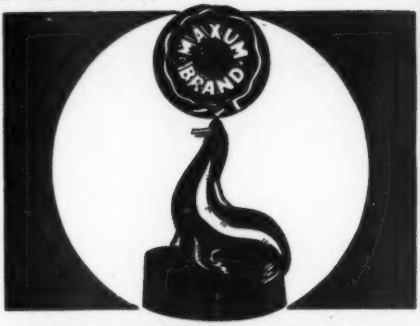

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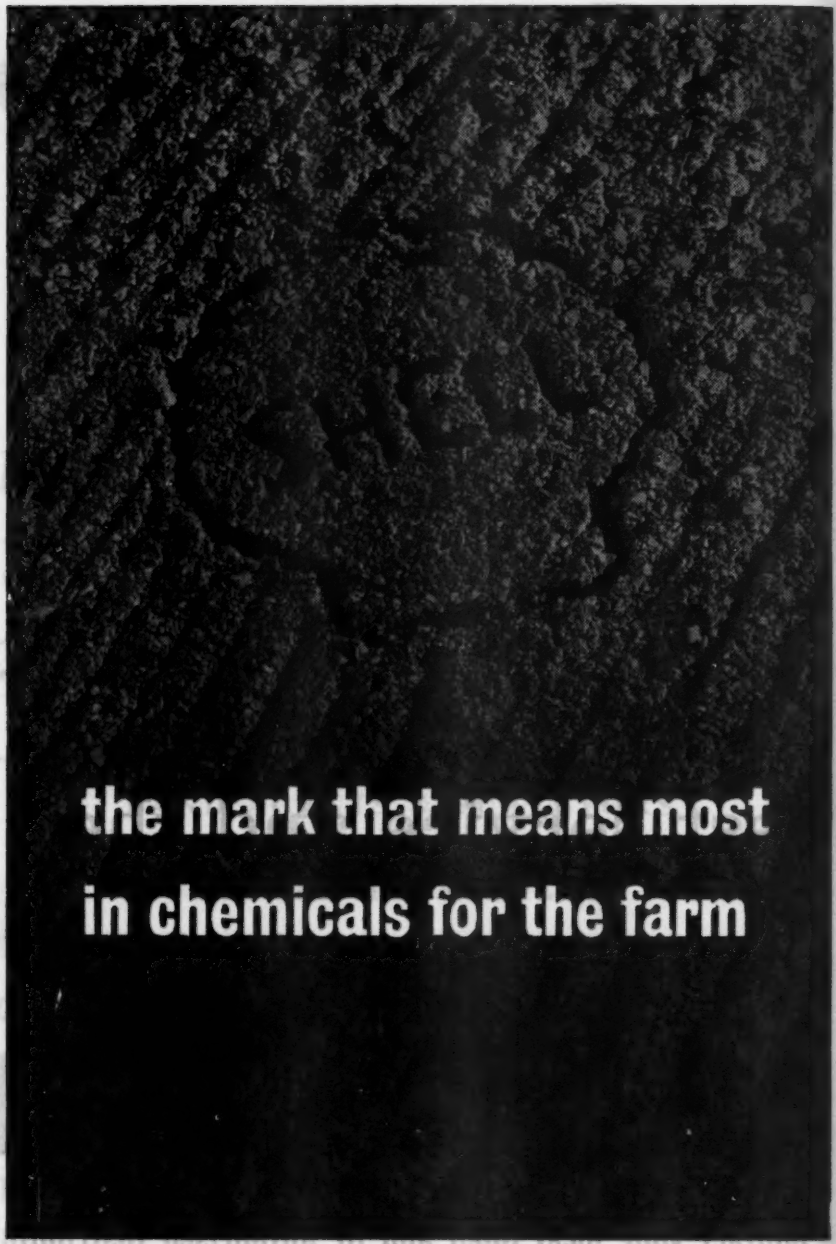

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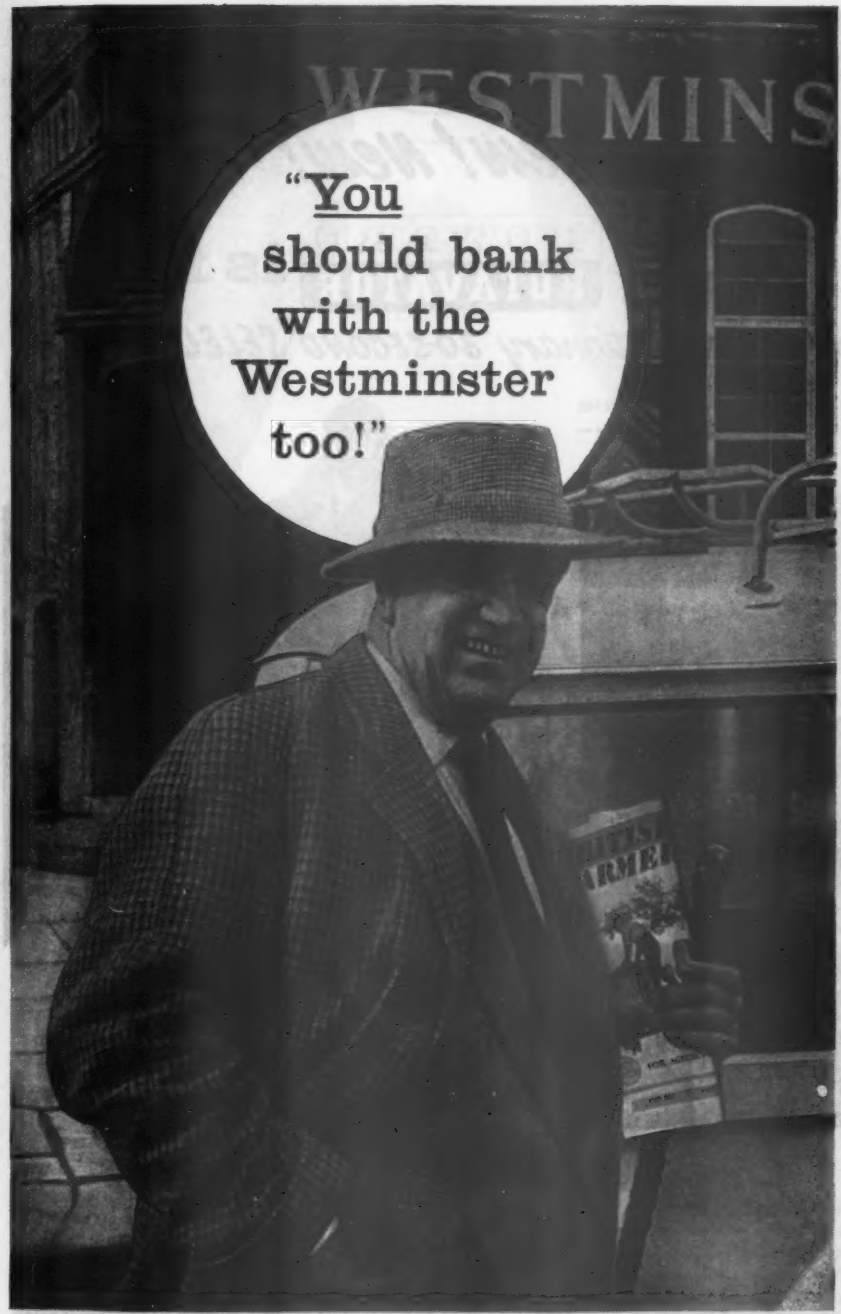

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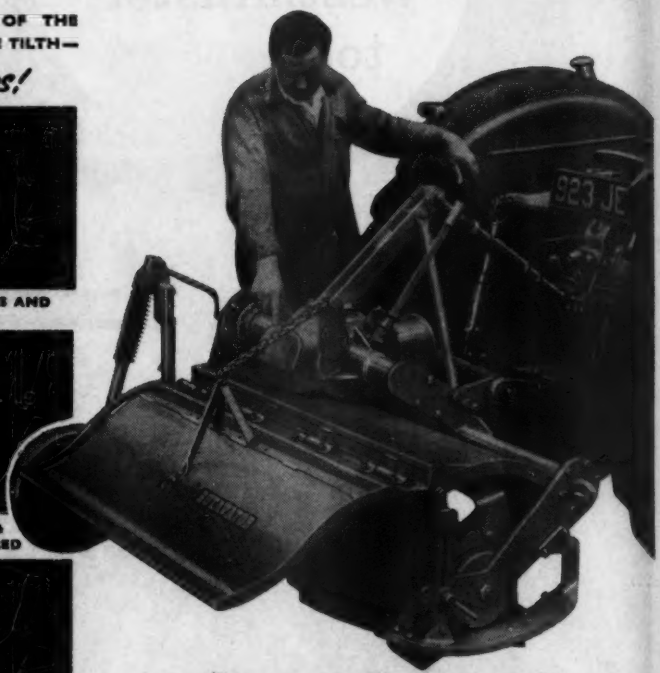

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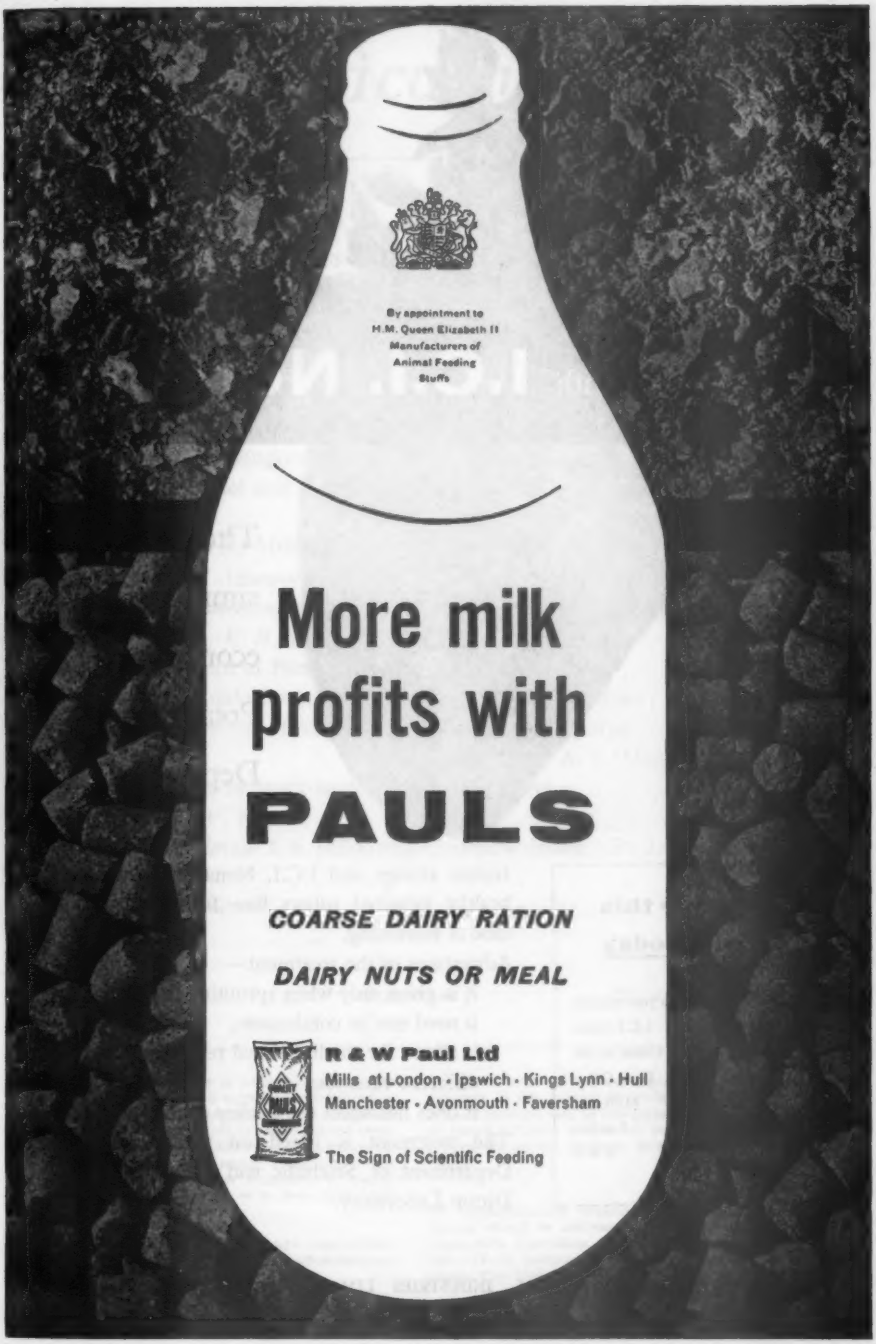
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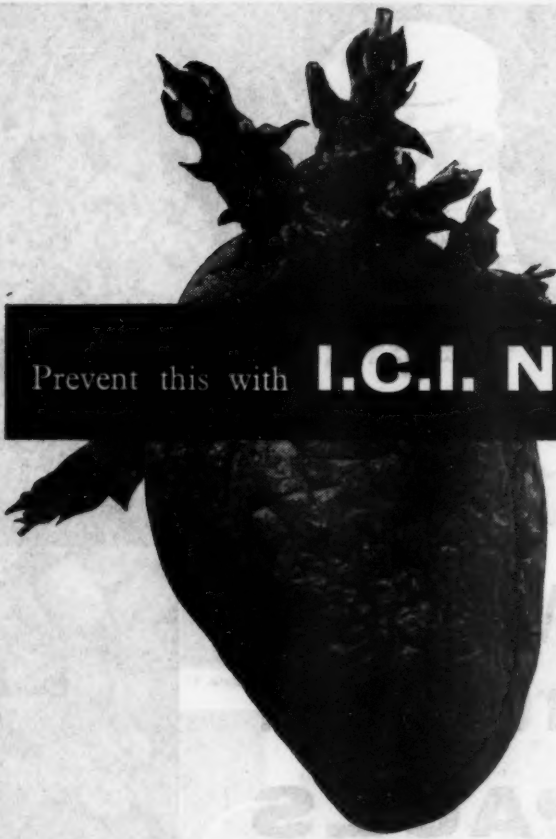

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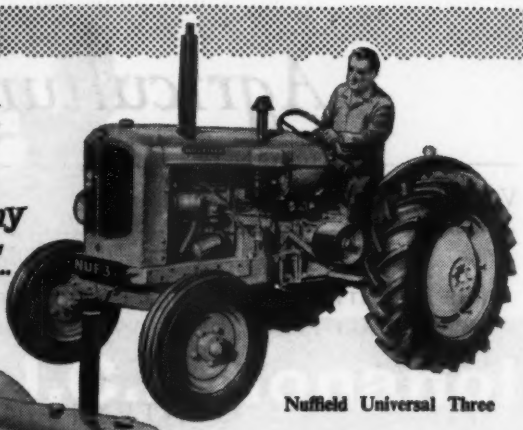

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Slaughter-houses in England and Wales

A. W. ANDERSON, O.B.E., B.SC.

Mr. Anderson outlines the provisions of the Slaughter-houses Act, 1958, and discusses how far they are likely to meet the needs of the various sections of the meat trade.

IN the late '20s and early '30s, the severe agricultural depression stimulated various committees and commissions to consider how far the slaughtering facilities available might influence the marketing of fatstock. Although their recommendations differed in many material respects, all thought a reduction in the number of slaughtering points would be desirable in the interests of orderly marketing of fatstock, better use of by-products, and on public health grounds. Accordingly, provision was made in the Livestock Industry Act, 1937, for three central slaughter-houses to carry out all the slaughtering for three defined areas of the country, as an experiment to ascertain whether centralized slaughtering would be suitable for adoption generally. The outbreak of war in 1939 stopped all development.

According to official figures, there were in England and Wales about 12,000 private and 120 public slaughter-houses operated by local authorities in 1938. Earlier figures for 1932 quoted about 16,000 private slaughter-houses. Without question, a number of them left much to be desired. On the other hand, many of even the smaller ones were well run and quite adequately equipped. The precautions necessary to maintain a high standard of hygiene and reasonable working conditions in a slaughter-house are in almost direct ratio to the volume of slaughtering. For example, the butcher killing one or two beasts on one day a week has little difficulty in producing wholesome clean meat. A multiplicity of slaughter-houses does increase meat inspection problems, however.

Some 500 slaughter-houses in England and Wales were used under control arrangements when meat was rationed. This figure is sometimes quoted as showing what can be done to "rationalize" the slaughtering industry, but the special circumstances that applied during the rationing period are often overlooked. During that period the Government was the sole buyer and slaughterer of all livestock for human consumption. Because of the general shortage of meat the primary object of the rationing scheme was to allocate meat to the butchers more or less on a quantity basis to provide a ration for each consumer. It would not have been practicable under these conditions to give either the butcher or the consumer free selection of the class and quality of meat they preferred.

Much of the confused thinking before 1939 and when meat rationing ceased arose from a failure to appreciate that slaughtering and slaughter-houses are not something apart, but only one link in the complicated chain

of distribution from farm to housewife, and that the pattern of the chain itself is continually changing. The term "slaughter-house" is in itself unfortunate in that it conveys to the lay mind a place merely for slaughtering animals, whereas it is really a food factory preparing meat for human consumption, and using highly skilled techniques. The French word "abattoir" is little better and has the added disadvantage that it is often mis-pronounced and misspelt. Perhaps someone can think of a better name, but I fear long usage has established the word in our vocabulary for ever. Be that as it may, it will clarify our thinking if we constantly bear in mind that a slaughter-house is a food factory.

At one time, it seemed that the official policy on slaughter-houses might dictate the pattern of the trade regardless of repercussions on producer and consumer alike. On the whole, wiser counsels have prevailed, but the issues are still bedevilled by such indefinite catch phrases as "moderate concentration", "areas to be served" and "factory abattoirs".

Objects of the 1958 legislation

The Government's policy for regulating the future provision of slaughter-houses is now embodied in the Slaughter-houses Act, 1958. The main object of this Act is to lay down statutory standards for the construction and equipment of all slaughter-houses, and provide a procedure whereby these standards may be achieved within a reasonable time. Another principle of the Act is that the Government has recognized the need for meat traders to be allowed, during a limited period only, to establish new slaughter-houses of the required standard, or to modernize their existing premises in the places that best suit the needs of their businesses. All this will be subject to normal town planning requirements, and to there being no ban on private slaughter-houses in districts where slaughter-houses provided by local authorities already operate and meet the needs of their districts. But even where there are public slaughter-houses with a prohibition against private slaughter-houses, the Act makes provision for licences for new private slaughter-houses to be granted on appeal to the Minister and on his consent. In these cases the Minister would consent only if he were satisfied that the grant of a licence was necessary to secure adequate slaughtering facilities, or that it was expedient for special reasons.

Another provision is that each local authority is required to make a report to the Minister of the existing and proposed slaughter-houses in its district, indicating which of the existing ones are expected to continue to operate under the new standards of construction, and recommending a date when it expects that these standards can come fully into operation in the district. Safeguards are provided to allow traders enough time to draw up proposals for their future needs before these reports are made. The reason is that once the reports have been sent in, any further proposals to establish new slaughter-houses would require the Minister's consent.

Pattern of the trade

The merits or demerits of this Act must be appraised against the general background of the different requirements of the various sections of the trade.

As a broad generalization, there are three quite different persons or bodies requiring slaughtering facilities—the retailer, the wholesaler and the local authority. The retail butcher, usually in the rural or semi-rural districts, may best meet the requirements of his customers by buying livestock and providing his own slaughtering facilities. The wholesaler's requirements are more complicated. For various reasons he may not wish to provide his own facilities, but he must be able to handle a considerable volume of trade and present the meat and red offals in good condition for sale. Moreover he must have facilities to condition the various by-products. Of course, there is no clear-cut distinction between these two types of traders; an individual or company may belong to both. Finally, there is the local authority, more especially in large or medium-sized towns, who for various reasons has provided or wishes to provide a public slaughter-house, where facilities are made available for retailers and wholesalers.

The ever-changing pattern of the trade complicates matters even further. New techniques in the slaughter-house, in holding meat in temperature- and humidity-controlled conditions and in moving meat over distances, coupled with changes in the form in which meat is presented to the public, make it very difficult to foresee what the position may be a few years hence. Legislation regulating slaughtering facilities must not only meet the needs of the different users but must be adaptable to changing conditions.

Effects of the Act

Before examining the general provisions of the Act to see how far they meet these complicated requirements, it is pleasing to note that minimum standards are defined to which all slaughter-houses must conform. Hitherto the decision whether a slaughter-house was good enough rested on the particular local authority in whose area it operated. In the absence of a clear lead from central government, there were inevitably wide variations in the standards required by different local authorities. This in itself largely accounted for the unsatisfactory conditions in many slaughter-houses. It is interesting to speculate whether the 1958 Act would have been necessary at all if its minimum requirements had been thought out and applied in the '30s.

The provisions to ensure good working conditions for the operators and the most humane handling of livestock are other features about which there can be no differences of opinion.

From the trade point of view, the Act gives freedom to the retailer and wholesaler to build to his own requirements, subject of course to planning approval and the absence of a by-law giving a local authority which has provided a public slaughter-house, power to refuse to licence a private one. But freedom to build is restricted in time. After the time limit, the Minister's consent is required for a licence for a new slaughter-house.

For the local authority there are complications: the onus is on the authority to consult the traders in its district in drawing up the slaughter-house report. With goodwill and co-operation on both sides, however, the obstacles are not insurmountable.

I think it is in the time limits set that danger lies. A request for a licence by a private trader for a new slaughter-house after the time limit set by the Act may well be quite reasonable in changed conditions. In such circum-

stances the private trader's difficulties may be great. For however sound, in terms of business prospects, the trader's case for facilities may be, it may be difficult for him to get his application approved in view of existing slaughtering facilities, particularly if some of these are provided by a local authority. This time limit may well impose a heavy drag on development and tend to maintain the *status quo*, when the need is for rapid development.

Incidentally, people do not build slaughter-houses just for the sake of building or through pride of ownership; they do so only if building seems an economic proposition, bearing in mind freedom to expand and introduce new techniques regardless of the views of a local authority or of any other traders. A private trader in a public abattoir is necessarily limited in his activities and freedom to introduce new techniques. The public abattoir provides the minimum facilities. Provision for cutting up for the pre-packaging trade, efficient handling of by-products, edible and inedible, cannot be economically provided in a public slaughter-house used by all and sundry.

There is a further possible difficulty in that a local authority might introduce a by-law which, while particularly concerned with securing the full inspection of meat, might so tip the balance of costs as to make it uneconomic to send meat from outside into the area. If any such by-law were to be approved it could restrict the movement of meat, with repercussions on producer and consumer. The idea of dividing the country into areas to be served by particular slaughter-houses is completely outdated by developments in efficient handling and transporting of meat.

Challenge

The Act contains many desirable features and is probably as good a compromise as could be devised. It puts meat traders on their mettle to show they can provide slaughter-houses wherein clean meat can be prepared. I have no doubt the trade will accept the challenge, and silence once and for all the sweeping criticisms sometimes levied against it. Danger lies in stabilizing the position when the first blue print for the country has been decided, practically regardless of subsequent developments.

★ NEXT MONTH ★

Some articles of outstanding interest

SOME ECONOMIC EFFECTS OF GRASSLAND IMPROVEMENT *by C. H. Blagburn*

THE GILFACHWYTH STORY *by R. Phillips*

PIGLETS FROM BIRTH TO WEANING *by R. Braude*

THE FIRST TEN YEARS OF THE A.L.S. *by R. G. A. Lofthouse*

Home-produced Beef and the Meat Trade

G. C. EVERITT, M.SC., N.D.A.
*Ruakura Animal Research Station, Hamilton, New Zealand**
and
R. W. POMEROY, M.A., PH.D.
Agricultural Research Council, School of Agriculture, Cambridge University

Butchers now are looking for young animals with a low killing-out percentage: their customers are demanding small, tender joints with next to no fat.

BEEF is Britain's most important home-produced meat, but its position is constantly threatened by increasing imports of beef and expanding home-production of pork. We have therefore investigated the pattern of production and consumption of beef, not only as an aid to breeding and production policies but also to find a sound basis for research into beef production.

Determination of consumer demand by direct methods is extremely difficult, although an attempt has been made.[1] To get a general picture, we asked three large meat trade associations to prepare memoranda on the requirements of the trade, with special reference to the problems experienced by each association. The associations were:

(a) *The Federation of Wholesale Fresh Meat Traders of Great Britain and Ireland*, which is composed essentially of meat wholesalers who buy cattle mostly at auction markets but also by deadweight, slaughter them and sell the carcasses to retail butchers;

(b) *The National Federation of Meat Traders' Associations*, chiefly representing the interests of retail butchers, who may buy cattle alive or as carcasses from meat wholesalers;

(c) *The Association of Multiple Retail Meat Traders*. Many of the large meat combines selling meat through chains of retail shops are members of this association.

These three associations are not absolutely distinct entities. Members may belong to more than one: for example, a wholesale butcher may also possess a number of retail shops, or retail butchers in a particular area may combine to form a wholesale company. However, associations such as these are the links in the chain between the consumer and the producer, and their views may be taken as representing the requirements not only of the butcher but also of the consumer. It must be remembered that the producer has not only to satisfy the consumer's requirements but also those of his immediate customer, the butcher. For example, the latter is acutely interested in factors such as killing-out percentage and carcass conformation, which are not of direct interest to the consumer.

* When this article was written, Mr. Everitt was a member of the School of Agriculture, Cambridge University.

The following discussion of the principal factors affecting the value of the beef carcass expresses the three associations' opinions.

Weight suitability of beef animals

The ideal weight for steers is 9–11 cwt, with a corresponding weight for heifers of 7–9 cwt. Heifers tend to be fatter than steers at any given marketable live weight. These ideal liveweight ranges differ by localities to some extent: for example, at one extreme the north-west of England, particularly Lancashire, requires a lighter beast—a steer of 8–10 cwt and a heifer of 7–8 cwt, while the Midland area can take a slightly heavier animal. The kosher trade will readily accept a much heavier animal but forms a relatively small part of the total trade. Differences in demand are reflected, for example, in the price schedule offered by fresh meat traders to producers.

These weight ranges are determined by a number of factors. Firstly, in very small animals the yield of carcass in relation to live weight is relatively low; so is the proportion of high-priced joints like the rump and loin. Secondly, the ratio of bone to muscle in the very small animal is high and, thirdly, there is the economic point that overhead expenditure is greater when slaughtering animals of small live weight. No firm indications were given by the trade associations of the lower limit of live weight, but these factors are important in fixing it for any particular animal. The present minimum live weight in the fat cattle subsidy scheme is 7 cwt for steers and 6½ for heifers; animals below these live weights are not eligible for subsidy certification.

The maximum weight is controlled by better-known factors. In heavy animals the yield of carcass is higher but the amount of fat also tends to increase, and there is a likelihood of coarser, tougher meat which may be intensified by indifferent feeding. One of the main problems with heavy cattle is the difficulty of cutting the small joints demanded by the modern housewife. Economic circumstances, type of employment and the general reluctance of housewives to stew or braise meat in preference to simpler, quicker methods of cooking have all militated against the large, heavy animal. It is sometimes suggested that the difficulty of jointing heavy animals could be alleviated by boning and rolling the joint. Apart from the technical difficulties of such a practice, the value of bones removed, which have been bought at the same wholesale price as the meat, must be added to the price of the boneless meat, plus a charge for the labour employed in boning. This may increase the cost per lb of boneless meat by about 25 per cent but the average housewife tends to look only at the price of the joint, and does not take into account that the bone has been removed.

These are some of the problems which the ordinary family butcher has to face; they are much less acute for butchers with catering contracts with hotels, restaurants or army camps because these establishments can cope with large joints.

Fat problem

Consumer resistance to fat is common to all parts of the country and to all types of workers; the reaction is more marked in some areas than in others. This is particularly so where work is carried out under unpleasant conditions

such as the hot, humid atmosphere of the Lancashire textile mills and the heat and dust of coal mines. The belief that workers in heavy industry will eat fatter meat is no longer tenable. Inquiries in the Midland industrial area failed to disclose any preference for fat among the workers. This decline is, undoubtedly, largely a consequence of increased mechanization. Similarly, the demand for fat among agricultural workers is rapidly disappearing, although rural populations still accept a slightly heavier, fatter animal. A rather fatter selection of meat can be sold in London: this curious fact is probably due to the very large hotel and restaurant trade there.

The declining demand for fat is a long-term trend in the meat trade, but the process has been accelerated in recent years by various factors, such as:

the drive for quantity rather than quality meat production during the war, forcing the housewife to purchase over-fat meat against which she reacted when the opportunity occurred;
the tendency to replace meat fats in the diet by butter and margarine;
less physical labour;
with the increased price of meat the consumer wants all meat to be lean;
medical opinions on the adverse effects of eating animal fats; and
the preference for prepared packaged vegetable fats to beef fat for cooking.

Trimming excess fat from a carcass loses money. Trimmed kidney fat, for example, is virtually unsaleable, yet it has cost the same price as the rest of the carcass. Thus, if the carcass cost 2*s*. a lb and 20 lb of kidney fat has to be removed, which can be sold for only 6*d*. a lb, the net loss is potentially 30*s*. a carcass.

In assessing a beef carcass a butcher is greatly influenced by the amount of kidney fat, and prefers a complete absence—an ideal which is hardly likely to be achieved because of physiological limitations. Heifers, particularly dairy-bred heifers, are more prone to excess kidney fat than steers, and this is one reason why steers are generally preferred to heifers. Another is that heifers very rapidly become too fat, but steers can be held over quite a wide range of live weight, without becoming excessively fat. In some ways, however, intermuscular fat, in the brisket, for example, presents a more difficult problem. Excess kidney fat can be trimmed reasonably successfully, but fat in the brisket joint cannot without seriously mutilating the joint.

Fatness of carcasses is related to killing-out percentage, that is to say, the weight of carcass expressed as a percentage of the live weight. The butcher's stone of 8 lb was based on a concept of 57 per cent of the normal stone of 14 lb; traditionally a butcher would expect 8 lb of carcass beef from every 14 lb of live animal. All things being equal, the butcher's ideal killing-out percentage is as high as possible, which would mean over 60 per cent. In commercial practice today the percentage is usually much lower than even 57. Soon after the decontrol of meat in July 1954, the average killing-out percentage of cattle was estimated to be about 56, but by early 1957 this estimate had fallen to much nearer 54 per cent.[2] One of the qualifications for the present fat cattle subsidy is that certified cattle should have a killing-out percentage above 54. This decline in killing-out percentage over the years shows the demand for lean meat, because in general the higher the percentage the fatter the animal.

To obtain lean carcasses, therefore, the butcher today looks for animals which will kill out at less than 60 per cent, because commercial cattle are generally too fat at this point. Excess fat is less likely if the killing-out percentage is given by a light-weight animal; many of the carcasses in the 1957 Smithfield Show, which came from light-weight animals killing-out at over 60 per cent, were not excessively fat.

Breeds and crosses

It was to be expected that butchers would highly commend the recognized beef breeds, particularly the Aberdeen-Angus. The Hereford breed was criticized for its thick hide, heavy head and the heavy forequarter, which contains a high proportion of low-priced joints. To quote one of the trade memoranda, "the main trouble with the Hereford is the excessive fat in the brisket. This is a popular joint if lean but a fat one will not sell at any price".

Because much home-produced beef now comes from the national dairy herd, the associations were particularly asked for their views on the suitability of dairy breeds and crosses.

Opinions differed on the suitability of the Friesian; it produces a desirable lean carcass, but the ratio of meat to bone was stated to be low. It is well known that there is a broad division of this breed into the large-framed, heavy individual and the smaller, more compact animal: the latter is acceptable to the trade. The Hereford × Friesian, or "Black Hereford", was favourably commented upon generally, likewise the Hereford × Welsh Black in Wales and the Sussex × Friesian in the south-east. Very little comment was given on specific Aberdeen–Angus crosses, probably because of the difficulties of identification. In so far as any criticisms of the Aberdeen–Angus were encountered, they were that the breed characteristics of being polled and having a black coat were so dominant as to obscure the other half of the cross. Those animals that have been identified were liked, particularly the Aberdeen–Angus × Friesian, where the fineness of bone as compared with the pure Friesian was noticeable.

A criticism of the Dairy Shorthorn, which was otherwise generally accepted, was of the frequent occurrence of patchy fat, especially in heifers. Crosses of beef bulls on the Dairy Shorthorn were favoured.

Channel Island breeds and crosses, and the Ayrshire to a lesser extent, were almost unanimously condemned as being unsuitable for beef. The Hereford × Ayrshire was considered to be the best cross of any Ayrshire female with a beef bull.

A general comment on all dairy crosses was that they should have no store period and should be marketed at an early age and light weight. A characteristic difference between the beef and dairy breeds is that the latter have a much higher ratio of kidney fat to subcutaneous fat. Consequently, a dairy-bred animal tends to have excessive kidney fat, but this can be avoided to some extent by killing at lighter weights.

Age at marketing

More and more attention is being paid by butchers to the age of cattle at slaughter. This was recognized by the authorities when in March 1957 a

quality premium based partly on age was introduced into the fat cattle subsidy scheme. Perhaps the three most important factors considered by the consumer in assessing beef quality are a near-absence of fat, small size of joints and tenderness.

Heavier, older cattle not only yield larger, fatter joints but the meat is tougher, mainly as a result of the growth of connective tissue between the muscle bundles. This tendency towards toughness is offset by the intramuscular or "marbling" fat deposited between the muscle bundles. Well marbled beef is usually very palatable, but generally has a fairly high proportion of subcutaneous fat. Beef from young animals is tender without having to possess much marbling fat and, having very little subcutaneous fat, sells more readily to the general public, to whom the finer flavour of well marbled beef seems to offer little or no attraction.

Each association emphasized the great national economic loss resulting from damage to hides by the larvae of the warble fly, by horned stock and by incorrect droving and carrying. It would seem justifiable to discriminate in favour of de-horned or polled calves for subsidy under the Calf Rearing Subsidy Scheme, 1949.

Similarly, great stress was laid on the economic loss caused by *Cysticercus bovis*, a parasite the larval form of which exists in cattle and the adult tapeworm in man; infected meat must be kept in cold store for at least three weeks to kill the larvae, and consequently the meat must be sold at the lower price of frozen beef. This infection warrants research but equally, if not more, important is the loss from liver fluke. Although more is known about this it still remains to be eradicated.

These problems have been dealt with by Mackness,[3] and it is clear from the views expressed by the trade associations that wide fluctuations in supply are a major problem in the meat trade. The butcher prefers to keep his prices reasonably constant throughout the year, but to do this in recent years he has had to try to balance profits in the autumn against losses in the spring. His difficulties would be greatly eased if some means could be found of spreading the autumn peak of slaughterings over the year, and are exaggerated if large imported supplies happen to arrive during September/November at the peak of home-produced supplies. It is unfortunate that the peak slaughterings of cows and of steers and heifers coincide; the injudicious retailing of cow-beef can do considerable harm to the home-produced beef trade.

Generally speaking, consumers much prefer first quality home-produced beef, and imported beef is not a serious competitor. Good quality chilled beef however, can compete seriously with lower grade home-produced beef, particularly when it is regularly available and graded to a uniform standard.

This survey of beef production and carcass quality in England and Wales is financed by a Special Research Grant from the Agricultural Research Council.

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Less Concentrates for Milk Production

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Not everyone uses concentrates wisely: there is a good deal of extravagance, and an unjustified lack of confidence in the ability of home-grown bulk foods to produce milk.

SINCE the derationing of animal feedingstuffs in 1953, concentrates for dairy cows appear to have been used very extravagantly on many farms. Surveys in different parts of the country during the last few years (up to 1956) all show that an average of 3½–4 lb concentrates was being used for each gallon of milk produced. In 1954–55, figures obtained from 30 farms in the north-west, in a survey of milk production costs carried out by Manchester University Agricultural Economics Department, were as follows:

	Low-cost group	Intermediate group	High-cost group
	lb	*lb*	*lb*
Purchased concentrates	2·4	3·0	2·9
Home-grown concentrates	1·0	0·8	1·7
Total concentrates per gallon	3·4	3·8	4·6
Yield per cow (*gal*)	840	848	744

The *National Investigation into the Economics of Milk Production*, conducted by the Provincial Agricultural Economists in England and Wales from a sample of 168 herds, revealed that for the year 1955–56 a total of 3·5 lb concentrates (2·5 lb purchased, 1 lb home-grown) was used per gallon for an average yield of 787 gallons per cow.

N.A.A.S. farm management work in Cheshire over the last few years has fully confirmed these figures on many dairy farms in the county; it seems that, on average, home-grown bulk foods are supplying little more than maintenance, in spite of the fact that many farmers believe they are obtaining maintenance plus the first one or two gallons without using concentrates.

On the small heavily-stocked farm, or where grassland management and manuring is relatively poor, the heavy reliance on concentrate feeding is understandable, but unfortunately, the same tendency to feed concentrates extravagantly has been found on many of the larger farms where grassland management has been intensified. Thus much of the potential gain from the more intensive management of grassland, and the increase in silage-making, has been offset by failure to economize in the use of purchased concentrates. Lack of confidence that home-grown bulk foods can produce milk is often the cause of overfeeding. The production of milk from concentrates is traditional, and many feel that reducing them will result in a considerable loss in milk yield which cannot be regained. Provided that the bulk feed is adequate in quantity and quality, this fall in milk yield does not occur even when quite substantial reductions are made in concentrate feeding.

Extravagance and waste

Inaccuracies in rationing are all too often responsible for extravagance. The scoop which is used to measure out the concentrates from the feed barrow is usually filled to the same level, whether it is 4 lb bran, barley meal or dairy nuts which is being fed. A system of regular checking and feed recording is as important as milk recording, but few farmers check or record. Small inaccuracies every day which are completely overlooked without a regular check can build up to large amounts over a year: a weekly or monthly calculation of the amount of feed used and the amount of milk produced can be a very salutary exercise.

Another common reason for overfeeding is the attempt which is frequently made to boost milk yield in a falling lactation. Concentrate feeding for steaming up can be justified, but good quality grass, kale or silage can also help in this. The success of a lactation depends largely on what happens to a cow during the first few weeks: if, as a result of poor feeding, bad milking methods or other factors, milk yields fall in the early stages of the lactation, the falls cannot be made good by heavy feeding later. Consequently, although it may well be wise to feed for the extra half gallon during the first six to eight weeks, an attempt to maintain milk yields by heavy concentrate feeding later in a lactation can prove very unprofitable. Feeding checks often show that it is the low-yielding cows which are being overfed. There is also much extravagance in concentrate feeding during the summer, when plenty of good grass is available. On many farms the cows are given a small amount of feed at milking time to keep them quiet while they are being tied up. This may be only 1 lb per head at each milking, but can amount to more than 3 cwt per cow over the grazing season, which certainly cannot be justified economically. Cows are very much creatures of habit, and farmers who have eliminated summer feeding have found that their herds soon become accustomed to coming in for milking without looking for feed.

Importance of keeping records

In an attempt to prove that bulk foods on the farm could produce milk and save concentrates, sixteen farms in Cheshire were selected to take part in a dairy cow feeding investigation in the autumn of 1956. Many of these farmers had discovered from a farm management analysis that they were overfeeding. All were hoping to reduce their expenditure on purchased feed, and were keen to co-operate in the investigation. Farm sizes varied from 15 to 250 acres, but in all cases home-produced foods in the form of hay, silage, kale, etc., formed a substantial part of the winter ration, and grassland management and manuring were in general above average. All the main dairy breeds were represented in the sample, but Ayrshires and Friesians predominated. At the beginning of the investigation the District Advisory Officer concerned made an estimate of food stocks and drew up a feeding programme. A fairly simple record of concentrate feeding was kept by the farmer, and visits were made monthly to collect the data and to check the accuracy of rationing. All concentrated feedingstuffs fed to the dairy herd, including those for dry cows and for steaming up, were recorded, and materials such as brewers' wet grains and wet beet pulp were included after conversion on a dry matter basis to concentrate equivalent. The total monthly

milk figure included sales, milk used on the farm, and milk for the farmhouse and men.

The investigation began on 1 November 1956, and the weighted average results for the first year ending 31 October 1957 are as follows:

No. of Cows	Stocking Rate (*acres per cow*)	Av. Yield (*gal*)	Home-grown concentrates (*lb per gal*)	Purchased concentrates (*lb per gal*)	Total concentrates (*lb per gal*)	Feed acres (*per cow*)	Gal per feed-acre	Winter milk (Oct–Mar) *per cent*
46	1·97	793	0·55	1·79	2·34	2·6	304	48

Although average milk yields for the previous year were not accurately known in all cases, from the records which were available the average appears not to have altered a great deal. In some herds there was a slight reduction in yield: in others there was an increase.

The results of the investigation were much better than we expected, but admittedly the mild winter and early spring influenced the results to some extent. During 1957 a smaller tonnage of compound feeds was fed nationally, probably because of the milder weather and a move towards greater economy. However, our figures on the same group of farms for the winter of November–March 1957–58 show that savings are being maintained—a total concentrate usage of 3·69 lb per gallon in 1957–58 compared with 3·77 lb per gallon in the 1956–57 winter.

There is no doubt that the regular monthly check made possible by the recording system has been one of the major factors in the savings achieved. Any tendency towards overfeeding quickly became apparent and could be corrected.

The value of a strict rationing system and feed recording was well illustrated on a holding carrying a pedigree Friesian herd with a 1,000 gallon average. An analysis of the farm accounts showed a high efficiency, but concentrate consumption was 4 lb per gallon. This was not unduly high considering the high milk yields, but the farmer was perturbed and decided that his rationing was not strict enough. He installed a mixing machine, a system of feed recording and a more accurate rationing system (even to the extent of weighing silage rations over platform scales). In 1955–56 his concentrate usage was reduced to 2·8 lb per gallon at a yield level of 1,040 gallons per cow. The following year concentrate feeding was cut further to 2·1 lb, by allowing heavy-yielding cows to make better use of bulk feeds. This further reduction was accompanied by a fall in yield of 60 gallons per cow (the largest in the investigation), but if we accept that the loss of yield was entirely due to reduced concentrates, which the farmer himself disbelieves, the reduction was still economic at prices ruling at the time.

Use home-grown bulk foods

The need to economize in supplementary feed when good grazing is available cannot be overstressed. High-quality grass can nourish cows yielding up to 6 gallons per day, and a number of trials carried out in different parts of the country have clearly shown that concentrate feeding to cows on good pasture is quite uneconomic. Recent figures from the Hannah Dairy Re-

search Institute show that the feeding of 8 lb concentrates per day produced only an extra 2¼ lb of milk.

On a 120-acre dairy farm in Cheshire, carrying 51 Friesian cows and followers, stricter winter rationing and the complete elimination of summer concentrates reduced the consumption of concentrates from 3·35 lb per gallon (average yield 828 gallons per cow) in 1955–56 to 2·09 lb per gallon (average yield 803 gallons per cow) in 1956–57. No concentrates were fed from early May until mid-September, when 39 per cent of the total milk was produced. The small heavily-stocked farm must inevitably rely more on purchased feed to keep up the volume of business necessary to produce a reasonable living. Even so, concentrates must be used economically, and full advantage of the farm resources must be taken first. One of our co-operators on a 66½-acre holding illustrates this point well. The holding was taken over by a young farmer in 1954 and now carries 40 cows, mainly Friesians, practically all the replacements being bought in. A small acreage of kale is grown, and approximately 150 tons of silage and some hay are made. In 1955–56 the 36 cows averaged 1,030 gallons per cow at the rate of 3·1 lb purchased feed per gallon. The next year cow numbers were increased (averaging 39), the yield average was raised to 1,207 gallons per cow and the concentrates reduced to 2·55 lb per gallon. Here the three major factors in profitable milk production have been effectively linked—a high stocking rate with productive units, a high yield and efficient food conversion.

Dairy farmers are now facing even lower returns for milk production, and although concentrated feedingstuffs are cheaper they must still be used efficiently if profits are to be worth while. There is still a cost margin in favour of home-grown foods, particularly grass and conserved grass products; but not only must home-grown bulk feed be produced in adequate quantity, it must also be allowed to produce milk. This does not necessarily apply only in the winter months. Too many farmers are still overfeeding concentrates in the summer but some have found that on well-managed grass no concentrates are necessary, even for high-yielding cows, at least during May and June—or longer in a favourable grass year.

The National Institute of Agricultural Botany announces a

HERBAGE SEED PRODUCTION CONFERENCE

to be held in Cambridge
on 18 and 19 November, 1958

The programme will include papers and discussions on:

Home-grown herbage seeds: present position and future developments
Planning of seed production on the farm
Establishment of seed crops
Aspects of management
Problems of red clover seed production
Spraying: weed control and chemical defoliation
Harvesting problems: including alternative methods and machinery.
Economics of herbage seed production.

Speakers contributing to this programme will include seed growers, seed merchants and technical advisers.

Full details can be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

More Sheep?

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Mr. Allanson shows how sheep can be fitted profitably into many existing farming systems by taking into account the policy of the whole farm.

FAVOURABLE prices, coupled with growing apprehension about future returns from milk, have induced farmers to contemplate sheep as a subsidiary enterprise, or even as an alternative to the embarrassingly productive dairy herd. The argument turns on the answers to four questions which the farmer should ask himself before going out to buy sheep: (1) would sheep add to the farm profit? (2) what sheep policy should I adopt? (3) what breed should I buy? (4) and how many sheep should be bought?

If the farmer wants the highest continuous profit, sheep should be introduced only when they replace less profitable lines of production or add profit to existing ones by using resources which would otherwise be wasted. The various alternatives can be compared by assuming specific methods of production, levels of performance and prices. Harrison and Stevens considered several situations in detail in a recent issue of this JOURNAL.*

Profits can easily be £5–£8 per ewe where sheep can be introduced without displacing existing enterprises. Many dairy farms are in fact stocked below capacity because extensions to the present accommodation would be too expensive, or because some of the fields are hilly, lack water or are too far from the steading. Even when the farm is fully stocked with cattle, competition does not usually occur when one sheep is brought in for each beast carried.

Farm profits fall where more sheep mean fewer cows, and some five ewes would have to be carried per acre to obtain the same profit on the small dairy farm—a truly formidable task even for the skilled shepherd. If, on the other hand, extra labour or buildings would be required before the herd size could be increased on the larger dairy farm, sheep might well give the same additional profit as the extra cows for a much smaller outlay.

Budgets on the same lines indicate that sheep give a better return than all but the more intensive forms of beef production, but they cannot match the profits from cash crop arable farming. Their role in the arable farm is thus restricted to using by-products such as sugar beet tops, catch-crop kale and ryegrass, or to folding off root and forage crops introduced to maintain soil fertility.

Capital and labour

The descending order of profitability which largely applies at the present time—cash crops, dairying, sheep, beef—is based upon returns per acre of

* Sheep or another Enterprise? J. E. HARRISON and G. J. F. STEVENS. *Agriculture*, 1957, **64**, 437–42.

land, but returns to capital and labour may often be of even greater importance to individual farmers. Sheep can give very high returns to labour on the larger farms, where one shepherd, with some seasonal help, can look after 400 ewes. Returns to capital compare very favourably with those from dairying, and the low capital outlay on specialized equipment gives an added flexibility which is particularly welcome in times of uncertainty. Nevertheless, output would have to increase substantially to compete with the margins from dairying on an acreage basis. In Kent, such an increase can come from the profitable association of sheep with herbage seed production, but competitiveness in other areas may well depend on a more favourable ratio of lamb and wool prices to those of milk, and on the marriage of the best traditional sheep-keeping techniques to some of the more promising recent developments.

Sheep, then, increase the farm profit in a restricted number of circumstances:

(a) on the arable farm with by-products, catch crops or forage crops for maintaining soil fertility;
(b) on dairy farms in winter, or as a complement to cows in summer, or when the herd size is restricted;
(c) on large farms which are short of labour or capital.

Flock policy and keep

These arguments for introducing sheep to the farm merely hint at the flock policy which should be adopted. A little hesitation may be excusable when confronted by such a wide choice of policies as:

Spring lambs—sold from March to May
Lambs—sold from June to December at 4–8 months old
Hoggets—sold from January to June at 9–14 months or as tegs at 21–26 months old
Tegs—sold from July to December at 15–20 months or 27–32 months old

Yet these groups do not cover the full range, since no distinction is made between fat and store sheep, nor between self-contained and flying flocks.

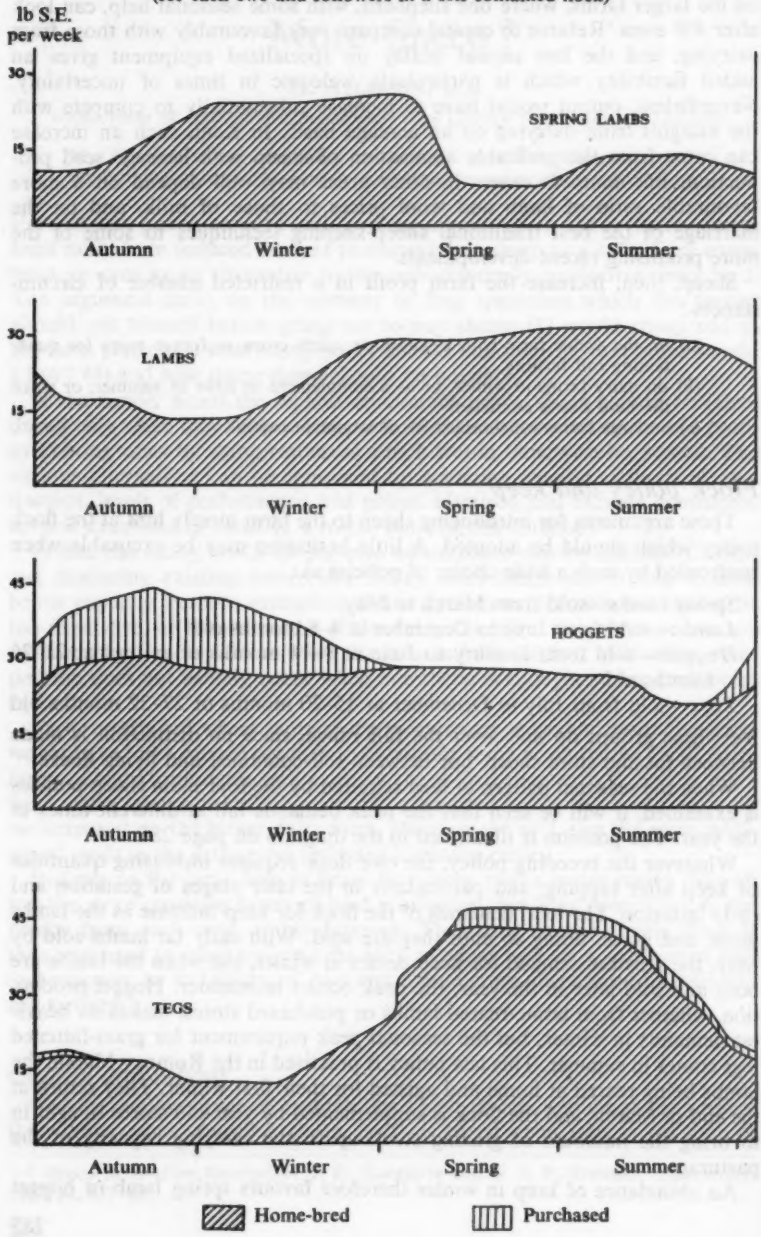
When the seasonal pattern of feed required by the four main sheep policies is examined, it will be seen that the peak demands fall at different times of the year. The position is illustrated in the diagram on page 286.

Whatever the breeding policy, the ewe flock requires increasing quantities of keep after tupping, and particularly in the later stages of gestation and early lactation. The total demands of the flock for keep increase as the lambs grow, and go on doing so until they are sold. With early fat lambs sold by May, the greatest demand for keep comes in winter, but when the lambs are born and sold later in the year, the peak occurs in summer. Hogget production, whether from home-reared lambs or purchased stores, makes its heaviest demands in winter, but the seasonal peak requirement for grass-fattened tegs comes in summer. This last policy is practised in the Romney Marsh, the lambs being reared at home and agisted for their first winter. They return at the end of March, and the flock is supplemented by year-old stores bought in to bring the numbers of grazing stock up to the carrying capacity of the pasturage.

An abundance of keep in winter therefore favours spring lamb or hogget

Sheep policies and their Seasonal Feed requirements

(for each ewe and followers in a self-contained flock)



production, and an abundance in summer favours the production of lambs or tegs for the autumn sales. More even supplies of keep throughout the year would allow greater flexibility; though most of the lambs would be sold fat in the autumn, there could be additional sales either of early fat lambs or of hoggets.

When the type of keep and the presence of other stock on a farm are taken into account, it is often found that there is only one practicable policy. Certainly, comparisons between the profitability of early and late fat lamb production are completely misguided, as they require different farming systems for their success.

Choice of breed

Pure breeds arouse such fierce loyalties that economic logic often seems inappropriate, but for those uncommitted the first point is that the breed must be suited to the particular sheep policy that has been chosen. For early fat lamb production the ewe must take the ram extremely early, milk well and transmit early maturity to her lambs. Fertility is important but becomes even more so in the next group, which lamb later for the autumn sales. Breeds for hogget production mature more slowly to greater weights, and heavy fleece weights and slow maturity characterize the breeds for teg production.

Certain breeds are not strictly competitive. For instance, the average Kent ewe, bred pure, does not compete with the Clun and Scottish Half-bred for fat lamb production, except as a producer of store lambs where the output has to be compared with that of the fat lambs of other breeds sold at the same age. The first choice of a group of breeds, therefore, like the choice of policies, is determined by the seasonality of keep.

The relationship of the type of farm, sheep policy and group of breeds is summarized in the following table:

Type of farm	*Max. available keep*	*Marketing*	*Policy*	*Typical breeds*
Arable	Winter	Spring	Early fat lamb	Dorset Horn,
			Hoggets	Kent crosses, Devon
Grass	Summer	Autumn	Late fat lamb	Scottish Half-bred, Clun
			Tegs	Kent
Mixed	Winter/Summer	Spring/Autumn	Flexible	Chiefly late fat lamb, with either early fat lamb or hoggets.

Within each group, the final selection of a breed is usually made on the basis of the output normally expected from each ewe. This is obtained by multiplying the average receipts for each lamb by the average number of lambs per ewe, adding the value of the ewe's fleece and finally deducting a figure for depreciation. The annual depreciation on Scottish Half-breds, Mashams and Cluns is high compared with that of many of the more local-

ized breeds, but their output is usually greater than the corresponding performance of the local contenders. Advocates of the more prolific breeds are apt to forget, however, that return on capital is another measure of efficiency and one, moreover, which may be of equal importance. As higher output is offset by the higher initial cost, the returns to capital are often smaller than for the less popular breeds. The big differences between the output of the local breeds and the prolific cross-bred ewes, which existed till recently, have been partially redressed by the tremendous popularity of the Scottish Half-breds, the Mashams, the Cluns and the Welsh Half-breds, which brought higher replacement costs in its train. These reduced the advantage in output because of the higher annual depreciation and, at the same time, reduced further the returns on capital.

When the size of the farm is the main factor limiting production, it pays to go in for the more intensive breeds with the highest output. On the other hand, if shortage of capital is the chief limitation, the local breed and the cheaper draft ewe often have the advantage, quite apart from any difficulties associated with the introduction of new breeds.

Numbers and management

When the breed most suited to the farm circumstances has been chosen, the fourth question of flock management arises, including that of the number of ewes to buy in. Where sheep must be complementary to dairy cows, one ewe for each cow is usually a safe ratio to avoid competition, though some of the more intensive grazing techniques offer less opportunity. Fears are often expressed about the danger of increasing the density of sheep stocking. Though fly and foot rot are less formidable obstacles to the newcomer, worm troubles and metabolic disorders still arise despite veterinary preparations and improved grazing management. Ewe performance usually declines as the sheep population increases, though this trend is by no means inevitable. Yet despite the lower output from each ewe, output per acre continues to rise with denser stocking, until at least three sheep on average are carried throughout the year on each acre. Sheep numbers can be increased to fairly high levels without undue risk, provided that routine veterinary precautions are taken. The increased output is, of course, gained at the expense of lower returns on the capital invested in the ewe flock.

The evidence against higher levels of nutrition and more intensive production is not sufficient to justify dogmatic conclusions, although the food conversion rate of the sheep appears too inefficient to warrant concentrate feeding. Profits can quickly be jeopardized if concentrates are required to tide the flock over the "hungry gap" before the spring grass grows. There is, however, one definite exception to this rule. Additional concentrates may be fed to accelerate the growth of early fat lambs so that they reach slaughter weight by the end of May. By the end of June in recent years prices have almost reached their lowest level, and it has then paid to keep the lambs into the autumn as long as they retain condition. The lower prices prevailing at that time do not justify the use of concentrates, however. Other methods of intensification such as more frequent lambing, hormone treatment and specialized grazing techniques are still in the experimental stage, but all appear to require more labour and skilled management.

Micro-climate Measurement in Stock Buildings

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This article describes how simple measurements of the air conditions in buildings—measurements which will give useful and practical results for the owner or stockman—can be made on the farm.

A FARMER can expect his stock to make the most of feed, grow best and be healthiest only when the climate in their house is favourable. As our knowledge of the climates (or strictly speaking, micro-climates) most suitable for the various farm animals increases, he will want to know whether his buildings do provide satisfactory conditions, so that if they do not he will be able to alter his housing or management to overcome the defect.

Recordings will most usefully be made in broiler and deep-litter laying houses, piggeries and calf houses. The values that can be recorded on the farm are temperatures, humidities and air currents or "draughts". It may be possible on occasions to measure also the air change or ventilation rate.

Temperature

There is no doubt that temperature data are of the most immediate practical use. For this, the farmer needs an instrument such as a thermograph, which is essentially a bimetallic strip that contracts and expands in direct relation to the air temperature. To this is geared a pen which leaves an inked continuous record on a clock-work chart, which may revolve once every 24 hours or (preferably) 7 days. At the end of this period, the clock is rewound, a new chart replaces the completed one, and the pen is refilled with special slow-drying ink. That is almost all the attention that it needs, apart from an occasional re-calibration of the thermograph against an ordinary mercury thermometer with the National Physical Laboratory mark on it. A thermograph can be bought for under £20, or hired for a small fee from the Meteorological Section of the Air Ministry.

A second instrument that has considerable use for measuring air temperatures is the maximum and minimum thermometer. Movement of the alcohol and mercury in this U-shaped instrument pushes small metal pointers to the lowest and highest temperatures experienced since the pointers were last reset, this being done with a small magnet which brings them back to the current air temperature. If the readings are taken regularly twice daily (for instance, at feeding times) a useful record of the range of temperature conditions in the house can be built up. The cost of this handy instrument is only

about 16*s*., but it has quite obvious limitations compared with a continuous recorder. For instance, any fluctuations within the extreme range since the previous readings were taken are lost; also one gains no idea when the changes occurred or how long they lasted.

Either of these instruments should be placed near the stock rather than somewhere which is handy for quick reading but does not show the environment felt by the animals. This means in many cases that the instrument must be protected from damage by a screen; this is perfectly satisfactory provided it allows free circulation of air through it.

As well as recording the air temperature in one or two selected sites in a house it is advisable to take "spot" measurements from time to time of gradients of temperature from end to end, side to side and floor to roof. If these are made in a number of positions a very useful indication is often given of the presence of draughts, stale air pockets, and cold and hot spots. For this an ordinary mercury-in-glass thermometer is needed. Also, it may be found useful to take surface temperature readings. These will give some idea of roof and wall insulation, and also litter temperatures. A flat-bulbed thermometer (preferably surrounded on the open side with a shiny metal sheath) and stuck on with modelling clay is all that is needed for these measurements.

Humidity

The interested farmer sometimes records the humidity of the air; almost invariably he uses Mason's wet and dry bulb hygrometer. This consists of two thermometers suspended side by side, the bulb of one being surrounded by a wet jacket. So long as the air is not completely saturated with water vapour, the reading of the wet bulb will be lower than that of the dry one as water vapour will evaporate from the jacket and cool it. By using tables, the observer can find the *relative* or *absolute* humidity of the air from the dry and wet bulb readings. The relative humidity is generally the figure required—usually expressed as the percentage of water vapour in the air, 100 per cent being saturation point.

However, Mason's hygrometer is really notoriously unreliable, as little air may pass over the bulbs when it is hung in a building, and so vapour may not evaporate properly. A modified form of this instrument, known as the whirling hygrometer, should therefore be used; in this the two thermometers are arranged as in Mason's but are mounted so that they can be rotated in the air to cause a current of air—representative of conditions in the building —to flow over them.

Very useful instruments also exist that enable direct readings of relative humidity to be obtained. The hygrograph, which is the companion to the thermograph, gives a 24-hour or weekly reading of the relative humidity on a drum. The basis of this instrument is a bundle of specially-treated human hairs, which contract or expand according to the relative humidity of the air; simpler hygrometers on this pattern, but merely giving "spot" readings of relative humidity, are now manufactured to give a 1–2 per cent accuracy. This is quite sufficient for our purposes; and although these hygrometers are more expensive, their simplicity makes them attractive. The same rules for placing should be followed as for thermometers.

Draughts and ventilation rates

Instrumental measurements of air velocities (draughts) are rarely made but in some cases they can be useful. Cigarette or pipe smoke has a certain limited use as an indication of the way the air is flowing; much better are the fumes generated by a cheap chemical, titanium chloride, which fumes copiously when the stopper of its bottle is raised. With care, titanium chloride can be used when the house is fully stocked—an essential for a good indicator!

From this point, we may look for more detailed information. We need a simple instrument to record air currents in all directions, simulating, so to speak, the animal body. The Kata thermometer is such a gadget. It is essentially an alcohol thermometer of a special type, with two marks etched on the stem and a small reservoir at the top. When it is heated in hot water, the alcohol can be made to expand up the stem, above the upper mark, and into this top reservoir. The time it takes to fall back from the upper to the lower mark is then recorded, the mean of three to five readings being taken. From the mean value the air speed can be read off a chart supplied with the instrument, the only other value required being the air temperature at the point where the Kata reading was taken. Several varieties of this thermometer have been developed; the silvered Kata with a cooling range of 130–125°F will have the greatest all round use. Virtually no skill at all is required for its use.

"Ventilation rates", that is, the number of times the air in a house is changed and the actual quantity of fresh air supplied to each animal or bird, cannot be measured on a farm under practical conditions unless ventilation is entirely by electric fans. One can then use a Kata thermometer or direct reading anemometer to measure the air speeds through fans or their ducts.

Conditions outside the building

A point of some importance that is too frequently overlooked is that if the results obtained inside the house are to be of full use they need to be compared with outside conditions—particularly with regard to temperatures. For this, a maximum and minimum thermometer can be set up on a north-facing wall, and wind velocity readings can be taken with the Kata at any time. It is also helpful to know that the Meteorological Office publishes a daily weather report showing temperature, humidity and wind data collected at meteorological stations throughout the country. No farmer will be far from such a station, and can always seek particular information from it.

Useful as these instruments may be, we must not be tempted to overestimate the benefits from using them. At the final count, it is the behaviour of the livestock, their health and productivity, which give the best indication of the suitability of a building. But if everything does not appear to be as it should, and housing is a possible cause of the trouble, then one or more of the instruments described here may be a great help in tracking down the source of the problem. And if records are kept over a few seasons they will add to our store of knowledge, which is at present very small.

CORRECTION. The caption to the lower photograph on p. iii of the August, 1958 art inset should have been: Angus × Friesian cattle outwintered on a straw pad.

Pigeon Shooting

E. B. MARRIAGE

There is no better way of combining business with pleasure than pigeon-shooting.

THE wood-pigeon deserves a much higher position in the sport of shooting. Not only does it give a far more sporting shot than nearly every game bird; it is much more difficult to shoot because it approaches the gun naturally from all angles at varying speeds, directions and heights. A good shot will kill his rights and lefts of driven pheasants and partridges, but only the first-class shot will repeatedly do so when pigeon shooting.

Pigeons should not be looked upon as just vermin to be slaughtered, or something less attractive to shoot at than "clay pigeons", as is too often the case. They are sporting birds of the highest order, and the proficient pigeon shot will be able to hold his own in any company when shooting driven game.

Pigeon shooting has no close season. These birds are so greedy and so numerous that it is desirable to reduce their numbers. They breed to some extent throughout the year, and huge flocks migrate here from abroad. Last year I watched an arrival in South Hampshire on 2 July, which is an unusual time of year for them to come. Many more were crossing the coast at the same place and in very much larger flocks during the first week in November, which is the more usual time.

Unless you have land of your own, it is difficult to obtain the right to shoot pigeons. Farmers and landowners would far rather be molested by flocks of these voracious birds than run the risk of giving permission to an untrustworthy person to shoot (pigeon only) on their estates. Once permission is obtained through the recommendation of responsible persons, be sure you adhere strictly to the limits of your permit. No one should lightly vouch for any man unless he is absolutely sure of him. A defaulter lets down everyone concerned and throws suspicion on honest sportsmen.

Study the bird's habits

It is not enough to be a good shot to obtain a full measure of success; you must study the ways and habits of the wood-pigeon closely and learn them thoroughly. A casual observer will only very occasionally make "much of a bag" or get half the shooting he might with the same amount of effort. At different seasons of the year the pigeon must be looked for in varying surroundings. The weather has a great influence on its movements. The strength and direction of the wind have almost more to do with its flight and habits than anything else. In the winter, for example, large flocks of birds may roost for a week in fir trees sheltered from the north wind. The next night, when you have decided to wait on the south side for their arrival, you find very few come to roost there, and those that do so approach from the north-east, the freshening wind having changed to the south-west.

A wood-pigeon has about the best eyesight of any bird and is constantly on the alert for danger. The sportsman has to overcome its extreme caution, and the more he learns about its ways and conforms with perhaps seemingly unimportant principles, the better will birds come to his hide when he is shooting and the keener he will become to learn more of this fascinating side of the sport.

Having learned by fifty years' experience (beginning when I was a small boy) and by a great deal of practice to be pretty successful at pigeon shooting, I may be able to pass on a few hints which, as far as possible, will enable the young, keen person to enjoy equipping himself with the essentials cheaply. Shortage of space will not, however, allow me to go into complete detail.

To obtain the rebate of 24*s*. a hundred on cartridges used by the "solitaire pigeon shooter", it is necessary to become registered as a "Lone Wolf" pigeon shooter at the county offices of the Ministry of Agriculture and make the necessary returns.

Patience must be an attribute of the successful pigeon shooter, for there are sure to be occasions when there are fairly long periods between shots. These need not be dull for those who love country life. While you are quiet in your hide, animals and birds move close around you.

Careful watch has to be kept on where the pigeons are feeding and roosting, but before "line of flight" or other places have been found there are several different factors which all go to make a good day, besides the ability to shoot well.

Your coat and cap must be of a dark neutral colour which will blend with the shadow in your hide—dark green for preference. A conspicuous cap can spoil what might have been a good bag.

Decoys

The decoys must be lifelike to be successful. Many expensive types can be bought: I have tried a number, not always with success. For many years I have stuffed and set up my own (about a dozen of them at a time) which are absolutely successful, and cost little more than the price of the glass eyes. The only unusual features about them are that I take off the legs and let a spent .410 cartridge case into the artificial bodies to take the peg on which they are set up, and I use an adhesive to keep the wings in position and fix the tail to the wing tips in the same way. I keep the decoys dusted with insect powder, and wrap each separately in nylon or transparent wrapping when not in use and pack six to a chip basket. When in use they must be set up facing the wind and fairly closely grouped. Shot pigeons can be used as decoys only in winter: the flies spoil them completely in warm weather. They can be set up easily on eight-inch sticks pointed at each end. One point is pressed into the ground, and the head of the bird is impaled on the other, after the lower eyelids have been taken off with a sharp knife to make them appear more lifelike. The head is drawn slightly forward and the peg hidden against the breast feathers.

When the hide is near enough to a tree I like to loft one or two stuffed decoys on to a bare bough, with others on the ground nearby. I use a "lofter perch" to hook over the bough. The decoy rests on a peg in the top of it.

Home-made extending poles of brush handles and light tubing make good lofting poles.

Hides

The construction of the hide is important. No matter how it is made or what it is made of, there are certain essentials that must be observed. It must be roomy enough to cover you, your dog and the gear, out of sight from the air. It must also give ample space to swing the gun freely. The background must be solid, and high enough to give deep shadow for the whole of the shooter, including his head, when standing. A high folding camp stool is a great asset.

The material to make the hide should be chosen according to the position and the surroundings. In a kale field, a circular knee-deep hole can be dug easily and sacks laid round the top. A ring of stout sticks can be pressed firmly into the ground and kale plants tied to them to make a close screen. In such a hide you can turn round to face in any direction. The stuffed decoys can be set up on "kale high" sticks, so that they appear to be perched on the tops of the plants. A hide near a hedge in summer can be made of leafy boughs pressed firmly into the ground—high ones at the back, lower ones in front, arranged to give deep shadow. In a harvest field a really good one can be made in the same way, and covered on the outside with a good layer of loose straw.

It is really strenuous work to make a satisfactory hide, and at harvest time you are dripping with sweat before a good one is completed. And hides can seldom be used more than just a few times, as the wood-pigeon is very wary, and usually avoids a place where there has been a considerable amount of shooting. The answer is a portable hide that can be erected easily and quickly. I regularly use one that I made years ago and find it most satisfactory. It is light, rolls up and goes into my shooting brake comfortably.

The frame-work is made of string netting, fixed firmly to upright garden canes as spreaders. Three strands of thin garden line are used to strengthen the net. Bundles of 6-feet cane-like rushes (Norfolk reed), three or four butt-ends each way, are tied very tightly to the net and packed close together so that no spaces are left between them. The back and two sides are made in one piece. The front is a separate panel, supported on stakes and high enough to give cover when standing. The back leans forward and the sides slope towards the front. This portable rush hide can be easily camouflaged to suit any position, but usually it is quite successful in its ordinary state. A little foliage or bracken tucked in along the front to screen the occupant's face is always advisable. The keen young sportsman will enjoy making it and the cost is little more than his own handiwork.

To obtain the best sporting shooting, the positioning of the decoys in relation to the hide, the direction of the wind and sunshine, and the direction from which the birds are approaching, are extremely important.

Ideally, the wind should be south-west, so that the hide facing north-east has both sun and wind at the back of the shooter, enabling him to be in deep shadow (very important) with the pigeon approaching from the north-east. In these circumstances, the decoys should be grouped facing the wind 25–30 yards to either the right or left of the hide and slightly behind it.

Photos: *John Tarlton.*

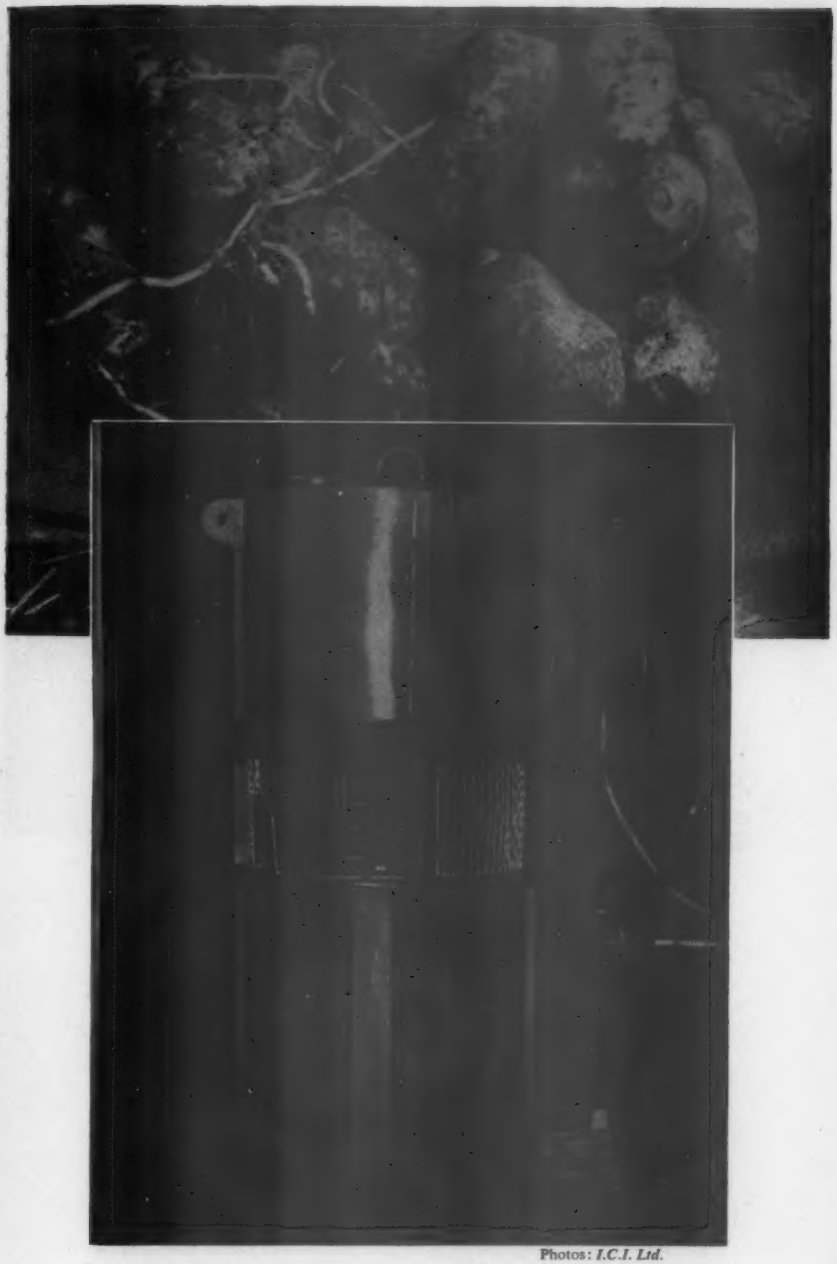
A "lofter perch" is used to place a stuffed decoy in an ash tree.

A warm, winter hide, made of baled straw camouflaged with gorse. It contains a knee-deep hole in which the shooter may stand for better concealment.

Photos: *John Tarlton.*

A shot pigeon and a stuffed decoy set up side by side.
The stuffed decoy is set up on a peg inserted in a spent cartridge case.

Suppression of Potato Sprouting in Buildings (Article on pp. 299–305)



Photos: *I.C.I. Ltd.*

Untreated potatoes alongside potatoes treated with nonanol, which has suppressed all sprouting.

A prototype fumigator designed to be used with nonanol.

Tube-grown Lettuce at Pershore (Article on pp. 296–8)

Lettuce seedlings raised in boxes in the usual way are pricked off into thin paper tubes at the 2-leaf stage. A team of four people can plant 2,400 an hour: No. 1 packs the tubes into boxes, No. 2 fills them with compost, and Nos. 3 and 4 prick off. The lettuces are still in their paper tubes of compost when transplanted to their final positions. This method of cultivation seems to reduce losses from *Botrytis* and the check at transplanting.

Photos: *Berrows Newspapers Ltd.*

Many birds will be lost without a trained dog. Peter, the springer I have at the present time, has turned out excellent for this kind of shooting. Why not train your own as I do? There are excellent books on how to train a gun dog and it is good fun. Don't forget when shooting in the summer to take water for your dog, and gently remove the feathers from his mouth when he retrieves a pigeon. He will quickly learn to appreciate these services. Wounded birds should be gathered and killed at once.

Disposal of the birds

Disposal of shot pigeons is something of a problem, though there ought to be a considerable demand for them. Usually only small quantities can be marketed locally; in the summer large numbers have to be bundled, tied to sticks and put on the night train to London, where they sell readily. I am told that wood-pigeon may appear on the bill of fare at some restaurants under the name of ptarmigan, grouse, or some other bird that is looked upon as a luxury. But why camouflage a delicacy? Here is the recipe for a delicious pigeon pie.

Dress two wood-pigeons and cut each into four parts having equal portions of breast. Cook in a pie dish until the meat is loose on the bones, then add rings of hard-boiled egg and one-inch squares of cooked pickled pork (¼ lb to each pigeon), seasoning to suit, and the pie crust. When the pastry is cooked, the pie is ready to serve. Two birds make ample and delicious portions for four people.

Officially Approved Crop Protection Products

Since the date of the publication of the Approved List *1958 (April 1958), the following names of proprietary products have been added to the List under the Ministry's Crop Protection Products Approval Scheme.*

2,4-D Amine Salt Sprays:		
Bugge's 2,4-D Selective Weed-killer Concentrate **(cereals and grassland)**	*Bugge's Insecticides Ltd.*	*BM 689*
MCPA Potassium Salt Sprays:		
Farmon "A" Plus **(cereals, linseed, and grassland)**	*Farm Chemicals Ltd.*	*DJ 773*
MCPA Sodium Salt Sprays:		
Bugge's MCPA 3 Selective Weed-killer Concentrate **(cereals and grassland)**	*Bugge's Insecticides Ltd.*	*BJ 688*

Applications are now invited for the official approval of proprietary monuron sprays. Full particulars can be obtained from the Ministry's Plant Pathology Laboratory, Harpenden, Herts.

A booklet listing Approved Crop Protection materials may be obtained free on application to the Ministry (Publications), Soho Square, London, W.1.

Tube-grown Lettuce at Pershore

A. A. FROST, B.SC.(HORT.)
Pershore Institute of Horticulture

Transplanting in cheap processed paper tubes containing compost is worth trying where *Botrytis* is troublesome and where poor soil checks the growth of early outdoor crops.

LETTUCE figures prominently among the crops grown at the Pershore Institute of Horticulture; it is particularly important in heated glass, cold structures and Dutch lights, and as a crop produced as early as possible in the open ground.

Two severe limitations to the production of this crop were soon encountered here: the heavy losses from *Botrytis* in crops under all forms of glass protection, and the poor and uneven growth of lettuce transplanted to open ground. The second was due to poor inherent fertility coupled with low pH. Both problems were soon found to have an important common factor. The lettuce under glass sustained its most severe losses from *Botrytis* because of the check at transplanting time. Lettuce transplanted to open land failed because it was unable to make new roots quickly and re-establish itself in its new environment.

It seemed probable that a technique of raising the plants so that they could be transplanted with a large ball of good compost would prevent the check under glass, and overcome the low fertility problem for open land crops.

The use of soil blocks immediately suggested itself, but there are two further important cultural factors in the control of *Botrytis*. The plants must never dry out during their growing period, and they should be transplanted above the general soil level, so that air can circulate beneath the plant. This minimizes the further extensive loss which occurs when the plant nears maturity because of stagnant conditions at the collar of the plant.

We thought that it would be unduly difficult to keep a soil block uniformly moist when it was above general soil level. On open land crops, the drying out of soil blocks, when a dry period followed planting out, had already been experienced. This could defeat the advantage of an undisturbed root system in some seasons.

The need was for some cheap individual container into which the seedling could be pricked off. Four years ago, a small paper tube became available, and all the early protected and outdoor lettuce produced here have since been raised in these individual tubes. The tubes themselves are small bottomless pots, made from thin processed paper. They have a 1½-inch top diameter and are 2 inches deep.

The seedlings are raised by conventional sowing methods in seed boxes, using John Innes seed compost, and pricked off into the tubes at a very early (2-leaf) stage. This is done as economically as possible. First the tubes are packed forty to a 2½-inch-deep seed box, which is then filled with compost. The operator heaps the compost well over the box, then strikes it off about half an inch above the surface of the tubes. He next presses down the com-

post with a firmer until the top of each tube is visible. A lettuce seedling is then pricked off into each of the 40 tubes in the box.

These three operations can be most economically carried out by a team of four: no. 1 packs the tubes into the seed boxes, no. 2 fills the packed boxes with compost and passes them alternately to nos. 3 and 4, who are both pricking off. Each box takes two minutes to prick out. The output of the team is therefore 60 boxes, 2,400 lettuces, an hour.

The compost is important: John Innes No. 2 has been used here, but it seems certain that for the very small extra cost per dozen lettuce, John Innes No. 3 will be employed in future. Any failures to produce good plants by this method have been because of nitrogen starvation, due to high nitrogen requirements involved in the decomposition of the paper pots. The growing-on of the seedlings is conventional. The boxes need no more water than a normal box of pricked-out seedlings. The incidence of *Botrytis* in the boxes of plants has been extraordinarily low each year since this method has been used, in spite of the fact that they are housed in unheated and badly ventilated Dutch lights during the worst months of winter.

The transplanting of the lettuces to their final positions was originally done with trowels, but transplanting under glass and in areas where mechanized marking out is not possible is now done by using a wooden pot plant rammer. This is simply a round piece of hard wood 2 inches in diameter and 8 inches long, one end of which is bevelled both sides, to form a blade 2 inches long and about half an inch wide. The operator pushes the blade of this tool 2 inches into the soil, and draws it towards him sufficiently far to insert the plant into the hole so made. The plant is, of course, still in its individual paper tube, which should at this stage have decomposed sufficiently for roots to have protruded through the paper. Care is taken to see that about half an inch of the tube shows above general soil level, as a precaution against *Botrytis* attack round the collar of the plant.

We find this method of planting far quicker than using the more clumsy conventional trowel, providing the soil is friable, and the tilth fairly deep at time of planting.

For open land planting, the method used is to draw 2-inch wide markers through the soil at a depth of 2 inches. The plants in their tubes are simply placed in these marking cuts and lightly firmed round. Again soil conditions and tilth need to be good. With outdoor plantings the tubes are buried to almost, but not quite, their whole depth in the soil.

Time of transplanting less critical

An important aspect of growing lettuce by traditional methods has been the timing of sowings, so that plants will be ready for transplanting at specific times. This is necessary to keep scheduled cropping programmes under glass, and catch the earliest markets for open land crops. When seedlings are sown thinly in frames, or even pricked out in boxes, the plants quickly pass the ideal transplanting stage, particularly during February and March. Experience here has shown that plants sown and pricked off into tubes at the same time can be set out into their final positions over periods of up to three weeks, without any marked difference in the final crop. In 1958, for example, lettuce intended to be planted out on open land sites in

the third week of February were not planted until the end of March. They were by then really big, but between 85 and 90 per cent were marketed as good quality lettuce.

This is a big asset under glass, since the fact that the grower can safely move a much bigger plant which will receive little transplanting check means that the crop is in the house for a much shorter time than is usual. Records for the 1957 and 1958 open land lettuce cropping illustrate the same quickness to mature:

	Pricked off	Transplanted	Cut
1957			
May Princess	End Dec–early Jan	23–25 Feb	17–28 Apr
Cobham Green	„ „	26 Feb–2 March	24 Apr–2 May
1958			
May Princess	End Dec–early Jan	23 March	11–20 May
Cobham Green	„ „	30 March–2 Apr	18 May–10 June

It is noteworthy that as a tube-grown plant on open land the variety May Princess withstood the bitter weather of spring 1958, and is very early maturing.

Cost

The cost of producing lettuce in this way has been carefully compared with the cost of conventional methods. The tubes themselves cost about £1 per thousand—just over 3*d*. per dozen. The two major operations are pricking off and transplanting. A team of four people prick off 60 boxes an hour, which means 4 minutes on each box. This operation, together with box handling, etc., has been reckoned to cost 1½*d*. per dozen plants. The average transplanting rate of both open land and protected crops is approximately 100 per operator per hour, including box transport and allied operations. Women are generally used for this job. The calculated cost of this stage is a further 3*d*. per dozen. Thus the total cost of raising and getting the plants into their final positions can be summarized as follows:

Cost per dozen lettuces	*d*
Paper tubes	3
Pricking off	1½
Transplanting	3
Compost	1½
Seed raising	½
Growing on from pricking off to transplanting stage	½
Total	10

This, of course, does not take into consideration the preparation of the planting site, or any factors not concerned with the plants themselves.

From the experience of the past three seasons of lettuce growing here, this method has proved its use at the Institute conclusively enough to be accepted as standard practice.

Suppression of Potato Sprouting in Buildings

W. G. BURTON, M.A., B.SC.

Ditton Laboratory, Department of Scientific and Industrial Research

Farmers can now safeguard themselves against heavy losses of late-stored potatoes by the use of a new D.S.I.R. method using a chemical called nonanol.

THE useful storage life of healthy potatoes is limited in practice by the growth of sprouts, which is accompanied by wilting and the danger of overheating. The importance or otherwise of preventing sprout growth depends upon whether it is necessary to store potatoes beyond the time when they would normally have sprouted and upon the actual loss involved in prolonged storage.

Potatoes are a staple food, consumed throughout the year at a rate which varies in Great Britain from about 7 oz per head per day during hot weather to some 10 oz or more per head per day during the winter. To meet this consumption, there must be available from 290,000 to 410,000 tons of potatoes per month, depending upon the time of the year and the weather conditions. From early July to October this requirement can be met by freshly harvested home-produced early and maincrop potatoes. From November to early July it must be met by stored potatoes supplemented by freshly harvested earlies, first from areas where these can profitably be dug early in the year (for example, from the Mediterranean countries and the Canary Islands), later from the Channel Islands and from this country. When allowance is made for these earlies, there remains a requirement—to be met from stored potatoes, either home-produced or imported—which is of the order of 400,000 tons in March, decreasing to perhaps 50,000 tons in July.*

Conditions of sprouting

The sprout growth to be expected on stored potatoes will vary with the year and the locality, and with factors such as the extent of disease infection and mechanical damage and the amount of soil stored with the potatoes. There are large varietal differences, but these are not so important in the present context, in that the great bulk of potatoes stored is made up of the two varieties Majestic and King Edward. Sprout growth starts earlier on King Edwards but is less vigorous, so that in April and the ensuing months it may be no more than on Majestics. From measurements over a number of years of the sprout growth on potatoes stored in Kent,[1] and allowing for cooler storage conditions in, for example, East Anglia and Lincolnshire, it

* In the ensuing calculations the approximate requirement of stored potatoes has been taken to be normally as follows (in thousand tons): March, 400; April, 300; May, 200; June, 150; July, 50.

is probable that sprout growth on Majestics may often be negligible by the end of March, though in some years it may be as much as 1 per cent by weight; by the end of April it may be some 2–3 per cent, and will increase at the rate of about 2 per cent per month thereafter. King Edwards may have sprouted to the extent of 1 per cent by weight by the end of February, though if the storage conditions have been cool, sprout growth may, as in the case of Majestics, be negligible at the end of March. Warm weather during the autumn and winter months may lead to appreciable sprout growth as early as November, particularly on King Edwards, but conditions later in the storage season are rarely such that this early acceleration of growth is maintained, and the figures for subsequent sprout growth given above are affected comparatively little. The judicious use of ventilation with cool air may retard sprout growth in some parts of the country, and in some years may delay development by perhaps a month or so. On the average, however, this method is unlikely to prove effective in this country for potatoes stored really late.[3]

Saving in weight

The water loss from potatoes is potentially much greater after sprout growth has occurred, because sprouts can lose water some 30–40 times more rapidly than mature tubers of equal surface area.[3] Under the conditions of bulk storage in buildings without forced draught ventilation, the potential rate of water loss is not reached, because a limit is set by the water vapour pressure deficit of the air among the tubers. In such a case sprouting has no marked effect upon the loss of water and the saving in weight to be gained by sprout suppression is something of the order of the figures given above for sprout growth alone. In practice, considerably sprouted potatoes stored in bulk without forced ventilation would overheat in warm weather, unless very little soil were included in the stack and the height of storage were limited to 6 feet or less.[4] Forced draught ventilation is normally essential if sprouted potatoes are to be stored late in bulk without overheating. The additional loss of water caused by the necessary minimum of forced ventilation could be expected to lie between 1 and 2 per cent by weight per month during May and succeeding months. When potatoes are stored in field clamps, the loss of water is greatly influenced by such factors as the amount of precipitation, the wind velocity and the orientation and construction of the clamp. In general, it is less than from potatoes stored indoors with forced ventilation.

From the foregoing it seems probable that in years when the whole of the requirement for stored potatoes is met from British sources but when there is no glut, and in the absence of any means of sprout suppression, the cumulative loss attributable to sprout growth must be of the order of 30,000 tons. The increased loss of water caused by sprout growth may amount to some 5,000 tons, a figure which could well be doubled eventually if the present trend towards indoor storage continues.

This yearly loss of about 35,000 tons of potatoes may not be regarded as very important, in that it represents only 0·7 per cent of the normal production. It should be viewed, however, not as a small proportion of the annual production, but in the first place as an appreciable proportion—ranging on

the average from about 4 per cent in May to some 10 per cent in July—of the potatoes which are necessarily stored late. In the second place it must be remembered that potatoes which have lost over 10 per cent in weight are spongy and of poor quality. Most potatoes stored without any means of sprout suppression until mid-May will be unacceptably wilted, because to the 4 per cent or so loss due to sprouting and the resultant enhanced water loss, to be expected by that time, must be added a loss of about 5–6 per cent due to normal water loss. This means that in studying the value of the widespread use of a method of sprout suppression there must be taken into consideration not only the loss of 35,000 tons but the largely avoidable poor quality of some 300,000 tons.

Saving in cost of grading

When appreciable sprout growth has occurred the cost of grading is increased. On the basis of experience it seems reasonable to take the cost of grading sprouted potatoes to be about 125 per cent of that of grading unsprouted potatoes when sprouting is about 1–2 per cent by weight, 150 per cent when sprouting is 2–4 per cent by weight, and 200 per cent when sprout growth is even greater. The extra cost of grading is eliminated if sprouting is completely suppressed, and grading costs late in the season may well be only half what they would have been in the absence of sprout suppression.

Expense related to duration of storage

In general terms, therefore, the value of sprout suppression to the farmer who stores potatoes late in buildings can be estimated to average about the following, the extent of sprout growth in each month being taken as the mean of that of the two main varieties at the beginning and end of the month, and enhanced water loss being taken as 1 per cent per month after the end of April.

For potatoes sold in March: ½ per cent of the selling price of the potatoes.
" " " " April: 1½ per cent of the selling price, plus 25 per cent of the cost of grading unsprouted potatoes.
" " " " May: 4 per cent of the selling price, plus 50 per cent of the cost of grading unsprouted potatoes.
" " " " June: 7 per cent of the selling price, plus 100 per cent of the cost of grading unsprouted potatoes.
" " " " July: 10 per cent of the selling price, plus 100 per cent of the cost of grading unsprouted potatoes.

It should again be emphasized that the degree of sprout growth is an *average estimate only*. The actual amount of growth will, as stated above, vary widely. Thus, in a locality where the general experience is that sprout growth is only some 1–2 per cent by weight in May, the value of complete sprout suppression would be only as given above for April. On the other hand, in some areas it might well often be worth ½ per cent of the selling price to suppress sprout growth until February. These considerations should be remembered when using the above general figures and the money values given in the table on p. 302.

The above figures represent the value of sprout suppression to a farmer

who stores potatoes late in any case. The value to a farmer who does not normally store late but decides to do so, provided he can suppress sprouting, is reduced by a number of factors—as for instance loss of interest on the capital represented by the potatoes, or the payment of interest on an extended bank overdraft, and the fact that, even leaving storage rots out of consideration, the potatoes are losing weight by evaporation at a rate of over ½ per cent per month until February—perhaps 1 per cent in March, 1½ per cent in April and 2–3 per cent in May and subsequent months.

The actual money value of sprout suppression obviously varies greatly from year to year. The following table gives some guide, taking the cost of grading unsprouted potatoes to be 8*s*. per ton and assuming that the workers could be used on other productive work if the time spent on grading potatoes were reduced. The values have been rounded down to the nearest shilling.

Approximate value to the farmer of complete sprout suppression

Selling price of potatoes (£/*ton*)	Approximate value of sprout suppression per ton of ware potatoes sold in:				
	March*	April*	May*	June*	July*
	s.	*s.*	*s.*	*s.*	*s.*
10	1	5	12	22	28
12½	1	5	14	25	33
15	1	6	16	29	38
20	2	8	20	36	48
25	2	9	24	43	58
30	3	11	28	50	68
35	3	12	32	57	78
40	4	14	36	64	88

* This table assumes 0.5 per cent by weight of sprouts in March, 1.5 per cent in April, 3 per cent in May, 5 per cent in June and 7 per cent in July. See p. 301 for considerations to be borne in mind when using the table.

A farmer cannot be sure when putting his potatoes into store how long he will keep them, when they will sprout, nor for what price he will sell them. For this reason a method of sprout suppression should preferably be such that the expense is directly related to the duration of storage after sprouting would have started in the absence of any treatment. Nor should the expense for any length of storage exceed that justified by a realistic appreciation of the probable selling price. Admittedly, there are years of scarcity when potatoes stored until May or June may sell for £35–£40 per ton and sprout suppression is very valuable indeed. Equally, there are glut years when, in the absence of any guaranteed price, many late-stored potatoes may have to be sold for stock-feed at a price which would justify but little expenditure on sprout suppression.

Nonanol as a sprout suppressant

The method of sprout suppression developed at the D.S.I.R.'s Ditton Laboratory during the past seven years[5] has been designed with the above considerations in mind, and is at present in the early stages of commercial development.† It involves ventilating the potatoes at intervals during the

† About 1,000 tons of potatoes were treated in this way in the 1957–58 storage season.

storage season, with a slow current of air containing a low concentration of the vapour of nonanol* (nonyl alcohol). This necessitates the provision of ducts under the potatoes and a supply of electricity for the ventilating fan. The method is thus only practicable for potatoes stored in a building. In view of the present trend towards the indoor storage of potatoes, and the obvious advantages of such storage, there seemed to be little point in investigating means of adapting the method for use in field clamps.

The requirements as to the type and spacing of the ventilating ducts are the same as for the ventilation of bulk-stored potatoes without the use of nonanol, and as such have been described elsewhere.[6] It is perhaps worth repeating that to give even distribution of the vapour the ducts should be spaced at not more than 6 feet between centres and should end not more than 1 foot from the walls of the store.

Nonanol is a colourless, rather viscous liquid with a camphor-like odour. Its boiling point is about 380°F and its flash point 180°F. This latter is sufficiently high for it to be classed as a non-inflammable liquid. Cold nonanol is not corrosive to any of the common metals, but when hot it attacks aluminium. Splashes in the eyes should be avoided and immediately washed out if they occur, but apart from this the use of this chemical appears to present no hazard. In common with other fat solvents, such as petrol, it will cause drying of the skin if handled without gloves. The Advisory Committee on Poisonous Substances used in Agriculture and Food Storage has recommended that nonanol need not be included in the Agricultural (Poisonous Substances) Regulations and that its use should not present a hazard to operators or to consumers of treated potatoes.

Nonanol vapour suppresses sprout growth completely at a concentration of 0·1 mg/litre—equivalent to 1 oz per 10,000 cu. feet of air. An Imperial gallon of nonanol weighs 8·28 lb and 1 oz by weight thus measures about 1·2 fluid ounces.

The lower the rate of ventilation the less the consumption of nonanol. If the rate is much less than 5 c.f.m. per ton of potatoes, however, the effectiveness of the treatment is reduced because the ventilating air, containing vapour, is diluted with air drawn into the potatoes by convection. Potatoes stored in bulk are in a state of dynamic thermal equilibrium with respect to the store air, in which state air is drawn into the stack by convection at a rate of roughly 5 c.f.m. per ton—this being sufficient to remove the metabolic heat as fast as it is produced. If the potatoes are ventilated with a forced draught, at a rate of 5 c.f.m. per ton, this is sufficient to suppress the natural convection. If they are ventilated with, say, only 1 c.f.m. per ton, then this will be supplemented by a further 4 c.f.m. drawn in by convection. If the 1 c.f.m. had contained nonanol vapour for the purpose of suppressing sprout growth, it would be so diluted by the additional 4 c.f.m. that the suppression of sprouting would be only slight. For this reason a rate of ventilation of 5 c.f.m. per ton is recommended.

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* Nonanol is a generic chemical name for alcohols containing nine carbon atoms. There are many alcohols, differing in the arrangement of atoms in the molecule, which could be described as nonanol, and they could differ in their effect upon sprout growth. The one which has been used for sprout suppression is 3-5-5 trimethyl-hexan-1-ol.

Method of fumigation

In the early work, nonanol was introduced into the air stream from wicks dipping into a container of the liquid.[5] For the commercial development of nonanol fumigation, the firm concerned designed another means of introducing the vapour by which the liquid was allowed to drip at a known rate on to a small hot plate placed near the inlet of the fan. This method proved very satisfactory, and commercial units, embodying various improvements suggested by experience, have been produced. They incorporate an alcohol tank, adjustable drip feed, fan, and a means of adjusting the rate of air delivery. The rate of drip should be adjusted to the tonnage of potatoes which it is desired to treat; for example, 200 tons would require a rate of ventilation of 1,000 c.f.m. and the air delivery should be set at this rate. Since the concentration required is 1 oz in 10,000 cu. feet, the rate of drip should be adjusted to deliver 1 oz in 10 minutes. The commercial units at present in production have been calibrated so that the rate of drip can be measured by counting the number of drops over a period of one minute.

Nonanol vapour will kill sprouts already formed, and, if these were large, necrotic pits occur in the tubers below the base of the dead sprouts. There may also be a danger of bacterial infection in these pits, followed by general rotting. It is therefore essential to start the treatment as soon as the first signs of sprout growth are observed. The method of management recommended is to inspect the top of the stack once a week throughout the period of storage. The straw covering should be pulled away in a few places and the potatoes examined down to a depth of about 6 inches. When the eyes on these potatoes are seen to be "open"—that is, when sprout growth is just starting—the treatment should be begun and left to run for a week or two. This should stop the growth completely. The treatment should then be discontinued. It is resumed for another period of one or two weeks when, in the course of the weekly inspection, sprout growth is seen to have started again. This discontinuous treatment is carried on throughout the time the potatoes are in store provided conditions permit—for instance, the unit would have to be switched off during periods of frost to avoid freezing the potatoes. It is advisable, though not essential, for the treatment to be stopped a week or so before grading the potatoes so that the smell of the nonanol should be dissipated. Even if this precaution is omitted, however, the smell quickly disappears during grading and distribution.

It must be emphasized that the use of nonanol vapour to suppress sprouting should not be allowed to interfere with normal good storage practices. For instance, the installation of the unit for introducing the vapour should be done in such a way that the ducts can still be employed, when the unit is not in use, for their primary purpose of cooling the stack. If ventilation is at any time regarded as essential—as for instance to cool down a local hot spot—then this must take precedence over the introduction of nonanol. When nonanol is being introduced all other entries to the duct system must of course be closed.

Cost of treatment

The cost per ton of treatment will depend upon the season, locality, the length of storage, and the tonnage stored—the first two because they influence

the onset of sprout growth and hence the amount of treatment necessary, the third because the longer the period of storage the more nonanol and electricity will be used, and the last because the greater the tonnage stored the less will be the capital charges per ton of the fan and hot-plate unit. Costings of the treatment in commercial use have indicated that the cost for storage until May is likely to vary between about 4*s*. and 10*s*. per ton, allowance being made for interest and depreciation on the unit, but not on the ductwork, which is assumed to be installed in any case.

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N.A.A.S. Experimental Husbandry Farms

High Mowthorpe

R. E. MACKENZIE
Farm Director

HIGH MOWTHORPE is a 1,080-acre chalk-land farm on the western side of the Yorkshire Wolds, 378–630 feet above sea level. Though larger than the average for the district, it is typical of a great area of land in east Yorkshire and north Lincolnshire. The nearest towns are Malton, eight miles to the west, and Driffield, fourteen miles to the south.

When the farm was bought by the Ministry of Agriculture in 1949 there were few buildings and no cottages, hence the need for a constructional programme which is still continuing. Of the original buildings, the old stables have been converted into calf boxes and a small cowhouse, and the barn has been repaired and now houses a food mixing plant and in-bin drying facilities for about 100 tons of grain. Storage for 250 tons of grain, again in ventilated bins, was provided by erecting a new building solely for this purpose. Other new buildings include a pig fattening house, cattle yards, a Dutch barn, and a potato store capable of holding 350 tons of potatoes. A glasshouse for chitting seed potatoes has also been erected.

A new cattle yard with facilities for group and, probably, individual feeding is on the drawing board. Improvements to existing calf accommodation

are visualized, again to provide facilities for individual feeding. The grain storage previously mentioned has proved inadequate, and further storage and drying facilities are under discussion.

As the farm is very isolated and exposed, it is essential to provide first class living accommodation for the staff. Seven cottages have been built for married workers, and some of the single men live in a hostel which is part of the farmhouse. With the expansion of the experimental programme, further cottages are required, to attract the reliable people essential for this type of work.

Farming system

The soil, overlying chalk, varies in depth from a few inches to three feet and contains broken chalk and, in places, quite large flints. The texture is open and normally free draining; the average annual rainfall is 30 inches.

Although this is an area where arable farming is predominant, the farming at High Mowthorpe has hitherto revolved round the three-year ley, introduced to carry the cattle and sheep required for experimental work. Well manured in the early spring of each year, and grazed in alternate years, the leys are cut in their second year for hay and silage. Mains water to each field means that except for experimental necessity the plough can be taken round the farm and each field put down to ley in turn.

In the past, the rotation has been a nine-year one, of which three years, as stated, have been in grass. It has now been agreed that part of the land will be farmed on a five-course rotation of seeds—wheat—oats—roots—barley undersown, which is more in keeping with normal Wold practice.

The following are examples of "one-year" mixtures used for sheep grazing on the Wolds:

(a) *lb per acre*		(b) *lb per acre*	
5	broad red clover	3½	Kersey white clover
4	Canadian alsike	3½	New Zealand P.P. white
4	New Zealand white (Mother seed)	1	ribgrass
2	trefoil		
1	ribgrass		
16		8	

About 150 acres of wheat are grown each year, chiefly Cappelle, with yields of over 40 cwt per acre saleable corn. The principal cereal crop is barley. In spite of the fact that the harvest on the Wolds does not normally start until after mid-August, a large proportion of barley is sold for malting. Of the oats, Sun II has proved the best yielder; all the crop is retained for stock-feed.

Potatoes, contrary to the general belief of not so many years ago, do extremely well on the high Wolds, and there have been most interesting developments in growing potatoes for seed. This can be very lucrative, and seed from the Wolds is in great demand in Lincolnshire and the potato-growing areas of Yorkshire. At High Mowthorpe about sixty acres of potatoes are

grown each year. We have not escaped blight during the last two years; in 1957 it was seen during the first week of August. Our normal practice is to burn off the haulm during the latter part of August, to prevent the spread of blight and check the growth of the potato itself. This year the King Edward stock has been sprayed against blight.

The livestock comprise beef cattle, a ewe flock, and a breeding and fattening herd of pigs. A small herd of cows is kept for multiple suckling, and about 150 calves are reared each winter: most of these are used for experimental purposes, about which more will be said later. Silage is the principal winter feed for the cattle, and approximately 500 tons are made each year. The ewe flock comprises just over 400 half-bred ewes. Sixty Cheviot ewes are kept on the farm and crossed with a Border Leicester ram to provide flock replacements. With this method, much more is known about the ewes than would be the case if replacements were bought in, an extremely valuable factor for experimental purposes. Pig experiments involving cross-breeding have been concluded, and the herd is to be replaced with pure-bred Large Whites in the late autumn.

Crop experiments

As many of the experiments are long-term, it would be wrong to prejudge the results, and I shall not give any figures, which at this stage might only be confusing. One experiment, begun in 1951, deals with straw disposal, a problem on many large arable farms where little or no stock is kept. The object is to measure the effect on succeeding crops of four different methods of disposing of the straw, coupled with two levels of nitrogenous manuring. All four straw treatments are giving the same results, the only differences being due to the effect of nitrogen.

Another long-term experiment is studying the effect on soil fertility of different types and lengths of ley—one-year, three-year and nine-year—under varying management. The crops following these leys—potatoes, spring wheat and barley—are weighed to assess the fertility built up by the various treatments. This experiment, laid down in 1952, will continue for many years. So far, there is no marked difference in the yields of the test crops; as might be expected in normal farming practice, the crop following a grazed ley tends to yield more than the crop following a similar ley which has been cut. The crop after a mown three-year lucerne ley shows an increase in yield compared with a crop following a mown three-year grass and clover ley.

Cereal variety trials carried out in conjunction with the National Institute of Agricultural Botany always attract the attention of our many visitors, and a few notes on last year's trials may be of interest. It must be emphasized that these figures should be treated with caution, as they refer to one year only and to one centre, and might be quite different another year.

Harvesting was quite early for the farm. Because of the high winds a good deal of shedding in all corn crops affected the yields, which were generally low. In the winter wheat variety trials, Mado and Leda showed distinct promise; Tavero was badly affected by shedding. Generally the first 1½ cwt of "Nitro-Chalk" gave an additional 3 cwt of grain. Of spring wheats, Svenno showed the best yield, but the losses by shedding were high in all varieties, yields therefore being low. Spring barleys and oats were all affected: Sun II,

an oat which always does well here, suffered slightly less than other varieties, and again gave the highest yield.

The results of experiments carried out on the Experimental Husbandry Farms are published in *Experimental Husbandry*. The following notes on (a) liming, and (b) seed and nitrogen rates for spring barley, relate to experiments completed at High Mowthorpe that have already been described in that publication (No. 1, June, 1956).

(a) Many Wold farms follow a five-course rotation, and lime is often applied for the rootbreak. The reason for liming is that it is necessary not only for the root crop, but also for the establishment of clover to be undersown in the succeeding barley. In our experiment, lime of different types was applied at three rates of application, and the yields of three crops, swedes, barley and clover hay, were compared with the crop yields where no lime had been applied. There was no measurable response to lime in any of these crops, from which it seems that in many instances there is no need to apply lime to Wold soils.

(b) A study of seed and nitrogen rates for spring barley was carried out from 1952–54. Four seed rates, 1, 1½, 2 and 2½ cwt per acre, were used at three levels of nitrogenous manuring. Yield was not increased by using seed rates of over 1 cwt per acre, and there was a greater tendency to lodging with higher rates. In all cases nitrogen increased yields, generally by 2 cwt for each 1 cwt of "Nitro-Chalk" applied to the seedbed. Here again, with the higher rates of application, there was a tendency for the crop to lodge, and the grain showed a considerable increase in nitrogen content.

Animal experiments

It has been mentioned earlier that the sheep flock consists of half-bred ewes, which are crossed with a Suffolk ram. They have the run of some 350 acres of ley during the winter, and are trough fed for only four weeks before lambing, which starts around 20 March, when they are brought into a field close to the buildings. After lambing they run in one of the sheltered dales, from where they are worked out on to the leys, and their diet is supplemented by mangolds. Over the past two seasons, lambing has been 175 per cent overall. The gross return per ewe, including wool, last year was £17 5*s*. 0*d*.

The principal experiment has been a comparison of the fertility, milking capacity and length of breeding life of ewes first bred from as lambs, and of ewes first bred from as shearlings. About 200 ewes have been involved in this experiment and the work is continuing.

Another experiment with sheep has studied the effect of ley management on the build-up of *Nematodirus* worm infection. One three-year ley was grazed with sheep during the first, second and third years: another, in the first and third years only. Samples were taken regularly to check the number of eggs and larvae in both sheep and grass. The experiment was concluded last year, and there was enough evidence to show that the incidence of infection had been greatly reduced by not grazing in the second year, although it was below normal throughout the country in 1957.

This year, two plots heavily infected from last year were used to test a new drug for the treatment of *Nematodirus*. Although the number of lambs

involved was small, we were able to show that the drug was effective. As *Nematodirus* kills many lambs in the north-east of England, it is proposed to continue the experiments, which may help to control this trouble.

The main cattle experiment on the farm since 1950 has been concerned with rearing steers from certain dairy breeds, and also from these breeds crossed with beef bulls. The dairy breeds concerned were Ayrshire, British Friesian and Dairy Shorthorn, and the beef bulls used were Aberdeen-Angus, Beef Shorthorn and Hereford. About 350 cattle have gone through the experiment and the last group (all Ayrshires or Ayrshire crosses) will, it is hoped, fatten in yards during the coming winter. Broadly, it has been found that within each breed or cross there is a wide variation in growth rate between individual animals. Good beef carcasses can be produced from these breeds and their crosses. A report on the first two years' work appeared in *Experimental Husbandry* No. 1: a second report will be published shortly.

Beef bull progeny testing

A start has been made with this work. At Rosemaund Experimental Husbandry Farm, Hereford bull calves are being "performance tested". They will later stand at M.M.B. A.I. Centres, and a sample of their progeny out of Friesian cows will be tested here. As some eighteen months will elapse before the calves are available, a start was made last autumn by purchasing 53 calves by Hereford bulls already standing at M.M.B. A.I. Centres out of selected Friesian cows. These calves, by eight different bulls, were reared on a high plane of nutrition during the winter and are now at grass. Satisfactory liveweight gains are being obtained, and there have been no losses. All animals will be followed through to slaughter.

Two small experiments conducted during the past year are being followed by another using younger animals. An investigation is being made of the risks involved where animals of both sexes are being implanted at twelve months old and again at eighteen months. It is intended to follow all the animals through to slaughter.

Two methods of calf rearing were compared last spring:

(a) Multiple suckling for a period of twelve weeks.
(b) Early weaning using the technique evolved at the Rowett Research Institute.

Under the conditions of the experiment, the liveweight gains were almost identical over the first twelve-week period. Half the animals in each group have been at grass since early July; the others are being kept in yards, and it is hoped that they will be fat at eighteen to twenty months old. All the cattle will be followed through to slaughter.

An experiment was started in 1956, using a three-year ley, to compare the liveweight gains of cattle grazed at two levels of stocking, with or without ewes and lambs. The cattle are at the rate of one or one and a half to the acre. Changes in the sward are being closely observed.

This account of the work at High Mowthorpe would be incomplete without reference to the valuable advice given towards the development of the farm by the Chairman of the Farm Advisory Committee, Sir William Prince-Smith, Bt., O.B.E., M.C., and his committee members. I thank them and the technical, office and farm staff for their enthusiastic assistance.

Dairy By-products in Stock-feeding

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A conference on dairy by-products in stock-feeding was held on 16 July, 1958 by the Milk Marketing Board in conjunction with Harper Adams College. The main emphasis was on the feeding of skim milk to pigs, but its use for poultry and calf rearing was also discussed.

THE superabundance of liquid milk in Great Britain has resulted in the Milk Marketing Board diverting larger supplies into milk manufacturing industries. This, in turn, has led to an increased production of by-products which the Board are anxious to sell back to farmers for stock-feeding.

Skim milk, when fed to pigs, has a higher biological value than its chemical analysis suggests. This extra value, probably due to its rich content of vitamins B, is greatest to younger pigs, but its quantitative effect decreases as the quantity of skim milk fed increases. For this reason, it is recommended that bacon pigs should be fed no more than ¾ gallon a day, plus a basal cereal diet suitably fortified with both calcium and vitamins A and D. Certain Irish agriculturists, who were anxious to feed only barley meal and skim milk to pigs, without supplementing the basal diet with minerals and vitamins, found that the extra calcium could be successfully provided by the addition of calcium chloride to the skim milk on delivery at the rate of 10–12 grammes per gallon. The vitamin A and D requirement can also be successfully met either by pouring 1 oz of cod liver oil once weekly over the basal cereal diet at feeding time, or by using a single dose (5 ml) of a special highly-concentrated vitamin A and D preparation soon after weaning: this will suffice for the rest of the bacon pig's life.

Whey contains more water than skim milk, and is also practically devoid of protein. Workers at Shinfield have found that it can be successfully and economically fed to bacon pigs *ad lib.*, provided a well-balanced protein-rich meal is fed with it. They recommend the feeding of a "sow and weaner" ration up to a maximum of 3 lb per day with *ad lib.* whey, but the meal can be successfully reduced to 2 lb per day once the pigs are about 70 lb live weight. Pigs normally reach a maximum whey consumption of between 3½–5 gallons per day at 150 lb live weight.

The storage of skim milk in unprotected galvanized iron containers can result in zinc toxicity when fed to pigs. PROFESSOR BASKETT quoted an instance where skim milk, originally having a negligible zinc content, contained 0·078 per cent zinc after souring in an unprotected galvanized container for one week. Pigs consuming one gallon of this contaminated milk plus 3 lb of meal would receive about 3,316 milligrams of zinc, compared with about 27 milligrams from a normal all-meal diet. Zinc intakes at this level might very well prove harmful, especially to young pigs.

Under normal weather conditions, milk can be kept "fresh" for a period of at least seven days by the addition of 0·1 per cent commercial formalin. However, it is important that the formalin should be added as soon as possible

after the milk has been separated. In extremely hot and thundery weather, it may be necessary to use a 0·2 per cent addition to prevent souring. Present evidence indicates that formalin additions at this level are quite safe when fed to bacon pigs.

Poultry

Birds can be raised successfully from day-old to point of lay on skim milk *ad lib.* and a basal cereal diet, suitably fortified with vitamins A and D, calcium, manganese and salt (and additional phosphorus after 8 weeks), without any marked wastage of protein. With laying birds, about 4 gallons of skim milk per 100 birds will replace the whole of the fishmeal where this is the sole protein supplement, but extra water and calcium will be required. Because of its high cost, it is uneconomic to use fishmeal as the sole protein supplement in the diet for any class of poultry. It is usual to employ a mixture of protein supplements. The greatest economy in poultry feeding through the use of skim milk is likely to result under existing conditions by omitting only fishmeal, dried skim milk or dried yeast, and retaining the other protein supplements in the basal diet. Under this system the quantity of skim milk used would, of course, be appreciably below the 4 gallons per 100 birds mentioned earlier. While it cannot be claimed that milk will control coccidiosis, there is some evidence that feeding skim milk or lactose can help chicks to resist infection. This appears to be due in part to the production of acidity in the intestines and caeca, and to the general nutritive value of milk in stimulating rapid growth.

When new galvanized containers are used for skim milk storage and distribution, the surfaces which will be in contact with the milk must be sealed with a suitable acid-resisting paint to avoid zinc contamination. Zinc becomes harmful to poultry at concentrations of over 100 p.p.m. of the diet. However, with galvanized equipment which has been well used, the same precautions may not be necessary. Practical results so far suggest that the inclusion of 1 per cent formalin does no harm to poultry.

Calves

Over a period of four years, Dairy Shorthorn heifer calves have been reared successfully at the Trawscoed Experimental Husbandry Farm, using a home-made gruel of 80 per cent dried skim milk powder and 20 per cent oat flour fortified with vitamins A and D. One pound of the mixture was added to one gallon of water, and fed to the calves at blood heat. They received 15 gallons of whole milk during their first fortnight, and were then changed to gruel over a period of two days. Hay and calf meal were also on offer. On weaning at 12 weeks, the calves had made a mean daily liveweight gain of 1·2 lb at a cost of 1*s.* 4½*d.* per lb.

Preliminary experiments using skim milk with 1 per cent formalin seem to show that it is a palatable and nutritious food for young calves, provided a change-over period of about two weeks from whole milk is used.

Game Fair

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THE Country Landowners' Association is to be congratulated both on its enterprise and, in the result, upon the success of its first Game Fair, held at Stetchworth, near Newmarket on 24–25 July. The object of this unique event (not only is it the first of its kind in this country, but it is probably the first of this pattern in the world) was to show how modern techniques of game rearing can bring within reach of any farmer farming his own land the profitable delights of a small-scale shoot. As the C.L.A. says "game can in fact be regarded as a useful supplementary crop, and good sport helps to make up for some of the burdens and responsibilities of ownership."

Here then, in the ideal setting of Lord Ellesmere's estate, was presented an epitome of English field sport throughout the ages, together with practical advice on the modern approach of integrating it with normal farming and woodland management.

An exhibition of the difficult art of falconry, preserved by the small but enthusiastic British Falconers' Club, not surprisingly drew the largest crowd. The conditions were extremely difficult, in that the spectators were lined four to five deep around the area where the display was given. Three birds were flown, two merlins and a peregrine. They were young birds, out of this year's nests, and had been flown loose for only four or five days. The merlins gave an enthralling display, repeatedly diving at the lure and being caught without difficulty by the falconer after each flight. It was obvious that the falconer had complete control of the birds. The peregrine, however, did not behave so satisfactorily; either he was not hungry or else he suffered with stage fright. Apart from one good flight round, when there seemed a danger that he might depart for pastures new offering more interesting quarry, he confined himself to half-hearted flights towards the falconer and made little attempt to show off what he could do in the air.

A film was shown, illustrating the patience and skill necessary to train birds of prey. Initial training consists of carrying the bird on the wrist for three days, night and day—one requirement alone which must have discouraged many visitors from joining the Club. In view of the many difficulties besetting an acquired skill in this sport, the disappearance of suitable open country, and the scarcity of rabbits and other legitimate quarry, it is not surprising that there are only twenty-five falconers in this country who regularly train and fly hawks. Also, under the Protection of Birds Act, 1954, all the birds of prey normally used for falconry in this country, with the exception of the sparrow hawk, are protected. The Act also prohibits the killing of certain of the traditional quarry species.

Archery is another age-old sport, dating back at least to the twelfth century (we remember the alleged unfortunate accident to William Rufus). Under the auspices of the Grand National Archery Association, the Isleham Archery Club showed what the skill of co-ordinated hand and eye could do in a tournament for both men and women. This sport has become increas-

ingly popular since the war and has the great merit that, after an initial outlay of £20 or so for the kit, it entails little expense.

Down "Gunmakers' Row" trade stands displayed guns dating from the sixteenth century. Surprisingly they have not altered as much as might be expected; the musket was evidently the immediate ancestor of the sporting gun. Modern weapons were shown, costing as much as 500 guineas—even £1,400 for a pair made to measure—but much more modest and very efficient guns can, of course, be bought by farmers and sportsmen for around £50, hammerless and non-ejector. British-made guns last a very long time, and good secondhand guns, whether hammer or hammerless and ejector or non-ejector, can be recommended to the farmer. Many old sportsmen still prefer the hammer gun.

Another stand showed a punt used by the wildfowlers of the last century alongside a modern prototype made of fibre glass. The latter is obviously built to the same pattern as its predecessor, but is much lighter and more manageable.

A purely historical exhibit showed game carts ranging from the horse-drawn era to the latest diesel engine truck. Among them was one owned by King George V which had been used for many years by shooting parties at Sandringham and Balmoral. It was fitted with a 1905 sleeve-valved Daimler engine and is still in going order.

The Ministry of Agriculture, Fisheries and Food had a striking display of the art of pigeon shooting from hides, and also showed the latest form of rabbit traps. Legislation banning the cruel, if efficient, gin trap almost coincided with the date of the show. The other Government exhibit was that of the Forestry Commission, which had for its story the ways and means by which deer can be fitted into the managed woodland pattern, and emphasized the importance of selective shooting. This was also underlined in an exhibit by the St. Hubert Club, which had a magnificent collection of heads, together with some awful examples of those from deer which ought to have been left to another day, or had developed malformed horns. Unfortunately, at neither exhibit was it explained how deer can be located, and this is something about which worried farmers on the boundaries of some parks and forests need advice, and need it badly. There was no encouragement to the exponents of archery to practise their craft on living targets. A recent case of an over-eager archer who shot at a deer has made it clear that it is no longer "done" to reduce the deer population by this once-favoured method. A bullet is more humane.

The rearing field, with working exhibits by the Fordingbridge Research Station and the principal game farms, attracted much interest; gamekeepers were well to the fore. It now seems comparatively easy to rear pheasants and partridges with few losses.

A special word of gratitude is due to the Earl of Ellesmere for putting his estate at the disposal of the C.L.A. for this important event and similarly to Mr. R. W. Elkerton, the Earl's agent, for his efficient handling of the layout and local organization.

Farming Cameo: Series 2

6. Eifionydd, Caernarvonshire

W. J. GREEN, B.SC.
District Advisory Officer

WITH its highly cultural and historical past, Eifionydd is probably the most picturesque area in Caernarvonshire. It lies in the southern half of the county and borders on Cardigan Bay: to the west is the long Lleyn peninsula, and to the east are the high mountain ranges of Merionethshire. The district is approximately rectangular, and stretches from Snowdon (3,560 feet) in the north-east down the Nantgwynant pass to Beddgelert, and along the Glaslyn River to Portmadoc. Its boundary continues along the coast through Criccieth to Pwllheli, and then turns directly northwards for about six miles to the Rivals (1,458 feet), near Llanaelhaearn. From these three characteristic mountain peaks the northern boundary line returns to Snowdonia via Graig Goch (2,301 feet) and Moel Hebog (2,566 feet).

These mountain peaks are acid igneous intrusions through mainly Ordovician shales. When the ice-age glaciers that covered Snowdonia moved south, thick glacial deposits were left over these shales. On the high mountain slopes, where the parent rock is acid, the high rainfall has produced various kinds of podsolic soils. Much of the central area is covered with glacial till from igneous rocks, hard shales and slate, while impeded drainage and the accumulation of organic matter have led to the formation of peaty grey podsols. Where the shale soils were not affected by glacial drift, there are some useful well-drained soils. Along the Glaslyn Traeth, Portmadoc, there are over 1,000 acres of marine alluvium and blown sand. The soil there varies from coarse sand to heavy clay loam; parts are liable to flood. Excluding the mountain areas, none of the land lies more than five or six miles from the coast; this accounts mainly for the mild winters and the usually rather cool summers. Annual rainfall varies from about 30 inches along the coast to over 150 inches in the mountains.

Apart from the common rough mountain grazings, there are about 20,000 acres of crops and grass and 37,000 acres of rough grazing in the district. Small farms predominate: there are nearly 400 holdings under 50 acres, about half of which are below 15 acres. Caernarvonshire itself is indeed a county of small farms, 80 per cent of its 5,000 holdings being under 50 acres. Most of them are family farms, and often labour difficulties arise, since many of the holdings cannot support hired labour.

Arable cropping has never been popular in the area. Poor harvesting conditions and laid crops have both contributed to the steady decline in the cereal acreage, which is now about half that returned in 1949. Oats is the chief cereal, followed by mixed corn. Very little wheat or barley is grown, although with the introduction of the newer varieties rather more has been grown during the last year or two on certain lowland farms. The number of combine harvesters operating in the district is increasing and, to meet this

new trend in harvesting, a co-operatively-owned grain drier was established last year.

The potato acreage has also halved since 1949, but local demand maintains a steady trade in earlies. Good crops are grown on farms between Criccieth and Pwllheli, where winters are particularly mild. Root crops have also declined, but much more kale is being grown, especially as a catch crop—sown in midsummer after a silage or hay crop.

Despite the decline in arable cropping, farm mechanization has gone ahead steadily, and on many small farms has passed the economic level. This rather high degree of mechanization may be condoned since it has eased labour difficulties at peak periods. Moreover, it has no doubt promoted a definite step ahead in the technique of ley farming. Grass is certainly the main and most important crop; during the last decade great strides have been made in the establishment and management of good grass. Aberystwyth "S" strains of seeds, lime and basic slag have all played their part, and considerably more nitrogenous and complete fertilizers are now being used.

During the last ten years, very many difficult, inaccessible or rocky fields have been reseeded to better grass. Along the Glaslyn River near Portmadoc several hundred acres of useless gorse-infested land were buster-ploughed and successfully reseeded. On farms near Dolbenmaen, hundreds of huge boulders were blasted or bulldozed so that the land could be reseeded.

The effort to produce more and better grass continues. Short rotation leys are finding a place on many farms, and strip grazing is becoming quite common. Last autumn, winter rye was sown on several farms for early March grazing, and when coupled with controlled grazing of late grass and foggage can probably reduce the duration of winter to under twelve weeks on most of the lowland farms. The result of this is an increase in the number of cattle and sheep.

From grass to milk and meat is another step. Caernarvonshire farmers pride themselves on the quality of their stock and its ability to convert grass to cash economically. No animal can surpass the hardy Welsh Mountain sheep on the poor rough mountain pastures.

Sheep farming, naturally, is the main and sometimes the only enterprise on the hill farms in the east and north-eastern sides of the area. Shortly before and during the war, the monthly milk cheque and the poor prices obtained for store stock brought many hill farmers into milk production. Now, with the changed emphasis making meat more profitable, and the high cost of alterations to conform with the Milk and Dairies Regulations, 1949, many have reverted to rearing. It fits in well with sheep farming and, furthermore, the breeding herd does well on the poor grazings and helps to improve them by eating the coarser grasses.

On the narrow coastal belt between Criccieth and Pwllheli, dairying takes first place. As milk production became popular, the Welsh Black cattle were displaced by mixed herds and crosses. Most of the milk now comes from farms with pure breeds of Ayrshire, Shorthorn and Friesian, but the native Blacks are still found on many farms. Many of the larger farms also carry sheep. In most instances, draft Welsh Mountain ewes are bought in the autumn from the hill farms and crossed with Wiltshire or Down rams for early lamb.

Between these two extremes is the larger central area of poorer land, containing substantial stretches of very poor heather and peat heath land. Milk still remains the main enterprise, but where the size of holding permits there has been a distinct swing to rearing. Welsh Black cattle are popular in this semi-upland area. The breed is easy to manage, produces useful yields of milk and a good steer calf for rearing, and thrives on the second-rate pastures and rough land that others would probably scorn.

Uncertain and fluctuating market conditions have reduced the number of pigs in the district, but almost every farm has its deep litter poultry unit, and egg production has increased enormously during the last few years.

A new water scheme that will serve the whole area is nearly complete, and may ultimately have a considerable effect on the pattern of farming in the district and on the volume of its production.

Farming Affairs

Developments in cereal varieties

Reference to the N.I.A.B. Guide for 1958 shows that new cereal varieties are still being offered for trial in this country in quite large numbers. More than fifty have come forward each year for several years. The official breeding stations and private breeders in this country supply some of them, but a considerable number are varieties from north and north-western Europe which are thought likely to have some suitability for our conditions.

The main demand from growers is still for varieties with a heavy yield of grain, short strong straw, and general field characters which make for easy handling. Progress along these lines has been very marked in the last ten years, particularly in wheat and barley. There is still room for improvement in grain quality, especially in wheat, but progress is being made and the yields of the newer varieties with good milling and bread-making quality are coming nearer to the Hybrid 46 level.

The improvement in the grain yield of oats has been less spectacular than that in wheat and barley, and the varieties with the shortest and best-standing straw have usually been lower yielding. It would help many growers if the present best grain yield and the present strongest straw could be combined in one variety. There are new varieties in trial from three private breeders in Great Britain which appear to compete in this class.

Successful efforts are being made to improve disease resistance in cereals, which should produce more consistent yields, if not a higher maximum. Barley and oat varieties resistant to mildew (*Erysiphe graminis*) are now in trials. Although this disease has never attracted much attention, it has been shown that it can cause grain losses of up to 20 per cent besides reducing the value of the straw. The range of oat varieties resistant to stem eelworm is being increased, and new material from the Aberystwyth and the Cambridge Plant Breeding Stations is in trials.

E. G. THOMPSON

Eggs and dry cleaning

Dry cleaning may seem an unnatural, even hazardous, method of cleaning eggs, but it is an excellent way of preventing subsequent deterioration during storage. Figures quoted at the Ministry's exhibition at the Suffolk Show indicated that in a trial with four batches of 60 eggs, dry-cleaned eggs kept as well as naturally clean ones, when stored at 70°F for eight weeks. Eggs wiped clean with a damp cloth began to show evidence of rotting when candled from the fifth week of storage, and after eight weeks 21 had gone bad. Steeping in water had an even worse effect. Rotting began in the second week and in the fourth, fifth and sixth weeks 12, 21 and 15 bad eggs were detected. By the end of the trial only 3 good eggs were left.

These results, obtained with farm eggs laid the same day on the same farm, emphasize the interesting possibilities of using ultra-violet radiation to detect washed eggs. When water and a detergent have been used, washed eggs appear violet under an ultra-violet lamp, whereas dry-cleaned eggs and un-

touched clean eggs are two different shades of red. The Egg Marketing Board has been demonstrating this very strikingly at this season's agricultural shows.

SYLVIA LAVERTON

Information service for farmers

A simple way of keeping abreast of the farming literature issued by the Ministry of Agriculture is to subscribe to the Standing Orders Scheme which is operated by H.M. Stationery Office. This is a special service for farmers and all others concerned with agriculture and horticulture, by which individual subscribers can be sure of receiving immediately on publication all new and revised booklets and leaflets on any aspect of farming which they select.

The procedure is simple. Write to H.M. Stationery Office at one of the addresses below, or to any Regional or Divisional Office of the Ministry, for a copy of the Standing Orders Scheme brochure. Mark the item or items in which you are interested, complete the order form and send it to H.M.S.O. with a deposit of £1 (more if you wish) to open a personal account. Your account will then be debited with the cost of the literature as it is sent to you.

Any of the Ministry's free literature on the selected subjects will also be included in the service.

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Harvested grain—dangers from carbon dioxide gas

The Ministry of Agriculture, Fisheries and Food reminds farmers that an accumulation of grain harvested wet generates carbon dioxide in a matter of hours. This can happen in any place where grain is stored, and as the gas (which is dangerous) is heavier than air, it will collect in the pits or ducts of a grain handling plant. Carbon dioxide has no smell, but its presence can be detected with a lighted match or candle: if the flame goes out, the place must be thoroughly ventilated before it is safe to enter. Anyone who is working in the place and feels faint or dizzy should get out at once. The test for the gas should then be made.

Sir William Ogg retires from Rothamsted

Sir William Ogg, who has been Director of Rothamsted Experimental Station for the past fifteen years, retires on 30 September. The son of an Aberdeenshire farmer, Sir William has won high honour and a world-wide reputation in the field of soil science. The Macaulay Institute was founded as a result of a report which he made while Advisory Officer in Soils at the University of Edinburgh and East of Scotland College of Agriculture, and in 1930 he became the Institute's first Director. In 1943 he succeeded Sir John Russell as Director of Rothamsted, and was knighted in 1948.

During his fruitful term of office at Rothamsted the staff has trebled; it now numbers over 400. Several new departments have been started, extensive additions have been made to the laboratories, and the old Manor House has

been converted into a hall of residence for some of the many post-graduate workers from overseas.

Sir William is retiring to his farm in Kincardineshire, where he has a dairy herd and grows a considerable acreage of seed potatoes. Our cordial good wishes go with him.

The Lawes Agricultural Trust have appointed as his successor Mr. F. C. Bawden, M.A., F.R.S., who is at present head of the Plant Pathology Department at Rothamsted. Mr. Bawden is a virus physiologist: his first work at Rothamsted, in collaboration with Mr. N. W. Pirie, completely changed previous ideas about the nature of viruses by showing them to be nucleoproteins. There are few practices now used to control virus diseases of crops that do not owe something to his work, or to work with which he has been closely associated. In 1955 he was the first recipient of the Research Medal of the Royal Agricultural Society of England.

Television *Farming* programme

Many farmers and farm workers will welcome the decision of the BBC to televise its *Farming* programme on Sundays at 2.5 p.m. instead of Thursdays at 12.30 p.m. as at present. This change will be introduced on Sunday, 28 September.

THE MINISTRY'S PUBLICATIONS

Since the list printed in the June 1958 issue of AGRICULTURE (p. 156), the undermentioned publications have been issued.

MAJOR PUBLICATIONS

Copies are obtainable at the prices quoted from Government Bookshops or through any bookseller.

BULLETINS

No. 21 Domestic Preservation of Fruit and Vegetables (*Revised January 1958*) 5*s.* (5*s.* 6*d.* by post)

No. 170 Diseases of Sheep (*New July 1958*) 4*s.* (4*s.* 4*d.* by post)

No. 176 Records and Accounts for Farm Management (*New June 1958*) 4*s.* 6*d.* (4*s.* 11*d.* by post)

OTHER PUBLICATIONS

Diseases of Sheep—Welsh Version (*New July 1958*) 4*s.* (4*s.* 4*d.* by post)

Output and Utilization of Farm Produce in the United Kingdom 1946–47, 1955–56 (*New July 1958*) 4*s.* 6*d.* (4*s.* 10*d.* by post)

Smallholdings Organized on the Basis of Centralized Services: Land Settlement Association Annual Report, 1956–59 (*New July 1598*) 2*s.* (2*s.* 3*d.* by post)

LEAFLETS

*Up to six single copies of Advisory and Animal Health Leaflets may be obtained free on application to the Ministry (Publications), Soho Square, London, W.*1. *Copies beyond this limit must be purchased from Government Bookshops, price* 3*d. each* (5*d. by post*) *and* 2*d.* (4*d. by post*) *respectively.*

ADVISORY LEAFLETS

No. 34 Plum Aphids (*Revised March 1958*)

No. 150 Millepedes and Centipedes (*Revised May 1958*)

No. 226 Red Spider Mite on Hops and Other Crops in the Open (*Revised July 1958*)
No. 318 The Mole (*Revised February 1958*)
No. 330 Acarine Disease (*Revised June 1958*)
No. 363 Sugar Beet Pulp for Feeding (*Revised March 1958*)
No. 368 Insects and Mites on Farm Stored Grain (*Revised July 1958*)
No. 468 The Modified Commercial Hive (*New July 1958*)

ANIMAL HEALTH LEAFLETS

No. 12 Blackhead (*Revised February 1958*)

One free copy of Farm Machinery and Horticultural Machinery Leaflets may be obtained on application to the Ministry (Publications), Soho Square, London, W.1. Copies beyond this limit must be purchased from Government Bookshops, price 6d. (8d. by post)

FARM MACHINERY LEAFLETS

No. 7 Tractor Engine Overhaul (*Revised June 1958*)
No. 18 Tripods and Racks for Haymaking (*Revised June 1958*)
No. 21 Barn Hay Drying (*New June 1958*)

HORTICULTURAL MACHINERY LEAFLETS (New Series)

No. 2 Boilers for Nursery Use (*New July 1958*)

FREE ISSUES

Obtainable only from the Ministry (Publications), Soho Square, London, W.1.

UNNUMBERED LEAFLETS

Dermatitis among Landworkers (*New July 1958*)
Full-time Agricultural Education in England and Wales 1958–59 (*Revised July 1958*)
Prevention of Accidents: Farm Machinery (*Revised May 1958*)
The Safe Use of Poisonous Chemicals on the Farm (*Revised May 1958*)

Book Reviews

Nuclear Radiation in Food and Agriculture. Edited by W. RALPH SINGLETON. D. Van Nostrand. 64*s*.

The publishers have prepared a series of books presenting the most important papers from the last Geneva Atomic Energy Conference, which was organized according to subjects. This particular volume deals with the papers relating to isotopes and radiations in food and agriculture, and covers all aspects of the subject—photosynthesis, plant physiology, pathology and cytology, as well as genetics.

Because a number of the papers (especially those from the United States, which were in the majority) not only brought out the latest developments but also gave lengthy introductions, they lent themselves very well for inclusion in this book.

There is no doubt that anybody who has not studied the Geneva papers before, and would like to learn of the advance made in this quickly developing field, will get great profit from them, although by now a number are outdated. There has been such great progress, especially in the fields of photosynthesis and food sterilization, that one cannot help wondering why such a book, which should have been rather easy to edit, took so long to produce.

It is obvious, since the editor limited himself to the presentation to the Geneva papers, that some chapters are out of balance. For example, one which should

be rather important—on soils and fertilizers—consists of one paper only.

This work is no more than a reasonable selection of papers on the impact of atomic energy on food and agriculture; neither is it a layman's nor a specialist's book, nor is it a book for a student of agriculture. However, I am quite sure that some interested people may find it useful to have in their libraries.

H.S.

Farming Weather. L. P. SMITH. Nelson. 15*s*.

This book helps us to understand, even if it does not persuade us to pardon, our weather. In this country we have, on the whole, a good agricultural climate. The weather, on the other hand, tends to be more changeable than it is in such areas as the Mediterranean and the Canadian prairies, where the climate is, agriculturally, less favourable. Thus weather plays an unusually prominent role in our day-to-day farming.

As head of the Agricultural Branch of the British Meteorological Office, the author has had a chance to learn what kind of weather data most interests the agriculturist. He gives the reader facts and figures about the sunlight, temperature, rainfall and evaporation to be expected in each season of the year in different parts of the country. From this and other raw material, he works out the average dates for the start and end of "growing weather" each year, the size of the summer moisture deficits and of irrigation needs, the summer humidity in relation to crop harvesting, drying and storage problems, and so on. The results are illustrated by a series of simple, clear-cut maps—mainly of England. Useful information about such hazards as frost, thunderstorms and "blight" weather is given, and there is a section on weather forecasts.

The passage in chapter 14 on the odds on, and against, the kind of weather one can expect after, for instance, a cold winter or a very hot summer is very stimulating. Thus the author states that the average odds against a very cold spring are about six to one; but after a very cold winter they shorten to two to one against. Again, he claims that a very hot summer tends to be followed by a mild autumn. Such information should help in deciding whether, for instance, one should, in a particular year, buy in hay if spring is likely to be late, or how much home-grown corn one can afford to sell if the grazing season is likely to stretch well in to the autumn.

The author wisely refrains from offering agricultural advice on the basis of his meteorological conclusions. He does, however, give the reader a great deal of thought-provoking and helpful material in a chatty, easy-to-read style. The data in this book should prove helpful, for a given farm or locality, in reaching decisions on such diverse problems as whether to increase corn acreage without increasing combining or drying capacity, whether to instal sprinkler irrigation, and when one can expect to get early bite if one sows Italian ryegrass and fertilizes it heavily.

The book contains a few obscurities which cannot, unfortunately, be clarified by seeking out the original source as there is only one reference and no bibliography. It tends to neglect Scotland and Northern Ireland. But these are minor criticisms of a timely and useful addition to our agricultural literature.

A.N.D.

Modern Poultry Husbandry (4th Edition). LEONARD ROBINSON. Crosby Lockwood. 36*s*.

Fundamental changes are taking place in the poultry industry. New methods of breeding, housing and general management are being adopted, and a great advance has been made in the field of nutrition. The fourth edition of Leonard Robinson's work takes all these in its stride: the latest methods of poultry breeding are fully dealt with, and there is an interesting explanation of how hybrids can be developed. There is also a simple illustration of recurrent reciprocal selection and population statistics as applied to poultry breeding.

The development of intensive housing for brooding, rearing and laying birds is discussed in detail. On the subject of breeding from intensively-kept stock, the author writes that "provided the birds receive a balanced breeders' diet and general management is sound, results are usually satisfactory. Particularly early in the season when most breeders report high egg production and better hatch-

ability." An interesting account is given of studies conducted at the Poultry Research Centre, Edinburgh, regarding the influence of controlled temperature on egg production.

The rapidly developing broiler industry is described in a comprehensive section that covers housing, equipment and general management.

The disease section is most lucid. Prevention is discussed and the latest methods of treatment are reviewed.

This book provides a complete and practical handbook on all aspects of the poultry industry. It has the authority which by this time one associates with Mr. Leonard Robinson's work, and at the same time can, through its simplicity and clarity, be described aptly as "a plain man's guide to poultry keeping". I recommend it.

R.F.

Control of Pests in Stored Agricultural Products with Special Reference to Grain. O.E.E.C., Paris. H.M. Stationery Office, London. 11*s.* 6*d.* (12*s.* 1*d.* by post).

The 170 pages of this book contain the report of a survey undertaken in North and South America and certain Mediterranean countries, on behalf of the European Productivity Agency of the O.E.E.C.

The primary aim of the survey was "to ensure that imports of human and animal food arrive in Europe free from active infestation by insects and mites and with the minimum of damage caused by their attacks".

With these objectives in mind, the work was largely a fact-finding operation, and the amount of information in the report is ample evidence of the thoroughness with which the survey was carried out.

Inevitably, when an expert embarks on a project of this magnitude, his advice is sought on many technical aspects of the problem, and a prominent place is given in the report to recommendations and constructive comments on existing organization and practice.

The importance of stored-product infestation is now accepted as a very serious international problem. This report, although ostensibly for the benefit of European importing countries, cannot fail to be of the greatest value to the countries visited during the course of the survey. Any effort directed to improving the quality of exports must at the same time raise the standard of foodstuffs intended for local consumption.

The report is excellently compiled and clearly written: there is a brief but useful general bibliography, and several appendices give detailed technical and scientific information.

It deserves careful study by all who are concerned with the preservation of foodstuffs.

G.V.B.H.

The Daffodil and Tulip Year Book, 1958. Royal Horticultural Society. 10*s.*

Of the year books covering various specialist interests published by the R.H.S., the *Daffodil and Tulip Year Book* is deservedly one of the most popular. It is a book for the daffodil "fancier", and duly adds its quota to the interesting record of progress and seasonal experience, with additional articles on special aspects of daffodil culture. The relative quality of exhibition varieties and the running made during the 1957 season represents the main interest of the current Year Book, of which almost a third is devoted to the fascination of the show bench. Appropriately, since the R.H.S. has become the International Registration Authority for daffodils, increased attention has been given to daffodils in the United States, Australia and New Zealand.

Tulips, as befits a flower which is no longer a "fancy" in England, receive scant attention, although the Darwin-fosteriana hybrids are interestingly described.

General reading for the daffodil enthusiast covers aspects such as breeding, and botanical interests are very well catered for in an article on the small jonquils. Temperature, with special reference to hot water treatment, dominates the "scientific" articles, which include one explaining the importance of the internal development of the bulb, especially the new buds, in relation to hot water treatment. It would add to the value of these articles if space could have been found for references to previously published work; for instance, the article on the control of daffodil flies could profitably be compared with the results of experiments by H. C. Woodville of the N.A.A.S., published in the 1956 Year Book. However, as one contributor suggests, this book is designed for folk with minds untroubled by chromosomes or chemistry, rather than

growers of daffodils for city-dwellers to buy.

All daffodil-lovers will revel in the technical perfection of the photographs forming the twenty-two illustrations and will regard this volume as a worthy successor to its predecessors.

K.H.J.

Farm and Horticultural Workers. (Choice of Careers. New Series No. 86). Central Youth Employment Executive. H.M. Stationery Office. 1*s.* 9*d.* (2*s.* 1*d.* by post).

Any book which sets out to give sincere advice to those seeking it is welcome, and this factual booklet should be of real help to boys and girls seeking to enter agriculture or horticulture. The first part describes the different kinds of work on farms, and the second details the various branches of horticulture. This is followed by a section on training, and appendices listing the Farm Institutes of England and Wales, and the Scottish Farm Schools. A notable omission in this connection is a list of the courses in agriculture offered by the Education Authorities in England and Wales, some of which have full-scale teaching farms attached to schools such as those at Rye Grammar School, Freshwater Secondary School and Lingfield County Secondary School.

Young people nowadays tend to acquire mannerisms more easily than manners, yet beneath this there is idealism waiting to be assessed and employed. Creative work with living things appeals to "those who have a natural liking for the land and for plants and animals". I gave a copy of this booklet to a boy and girl of sixteen, both of whom are taking up careers in agriculture. This sampling of "customer-reaction" elicited from them such comments as: "The book has not made getting into farm or garden work seem too easy, which is a good thing." "There is not enough about bad weather work and cleaning out animals." "Girls should have been given more encouragement, especially those who want to take up arable work." "It explains things in a way you can understand, and has very good pictures." Indeed, there are very good photographs, accompanied by excellent explanations, which greatly enhance the value of the pamphlet.

This little booklet will not only help boys and girls wishing to take up farm and market-garden work, but it will assist parents, teachers and others concerned with the guidance of young people in their careers.

J.A.S.

Books Received

Fundamentals of Soil Science (3rd Edition). C. E. Millar, L. M. Turk and H. D. Foth. Chapman and Hall (London), Wiley (New York). 62*s.*

The Black Fens. A. K. Astbury. Golden Head Press. 42*s.*

Deep Freezing at Home.. F. D. Smith and Barbara Wilcox. Andre Deutsch. 15*s.*

Rothamsted Experimental Station Report, 1957. 10*s.*

Welsh Plant Breeding Station Report, 1950–56. Copies may be obtained from the Director of the Station, Plas Gogerddan, near Aberystwyth. 7*s.* 6*d.*

The Theory of Evolution. John Maynard Smith. Penguin Books. 3*s.* 6*d.*

The Aberystwyth Strains of Grasses and Clovers (Leaflet Series S. No. 6). Welsh Plant Breeding Station, University College of Wales, Aberystwyth. 2*s.* 6*d.*

AGRICULTURE

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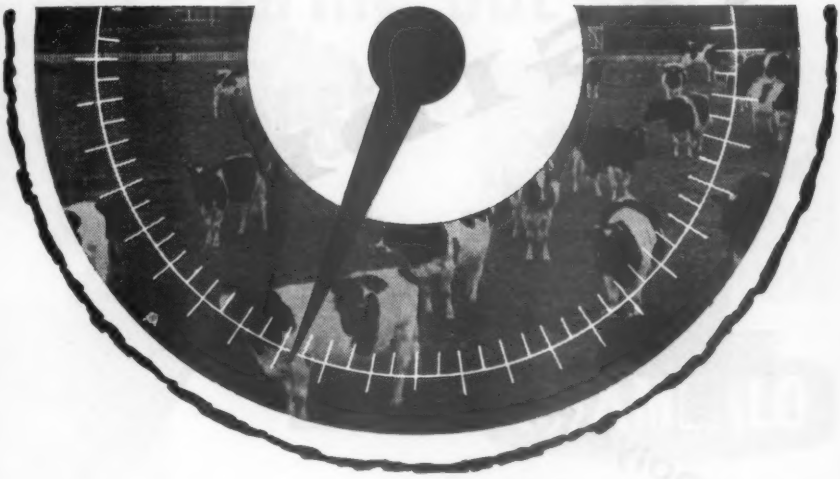

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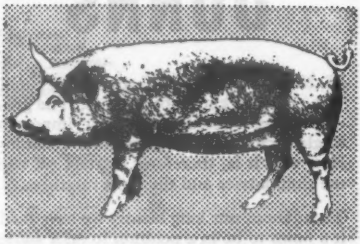

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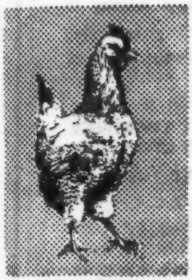

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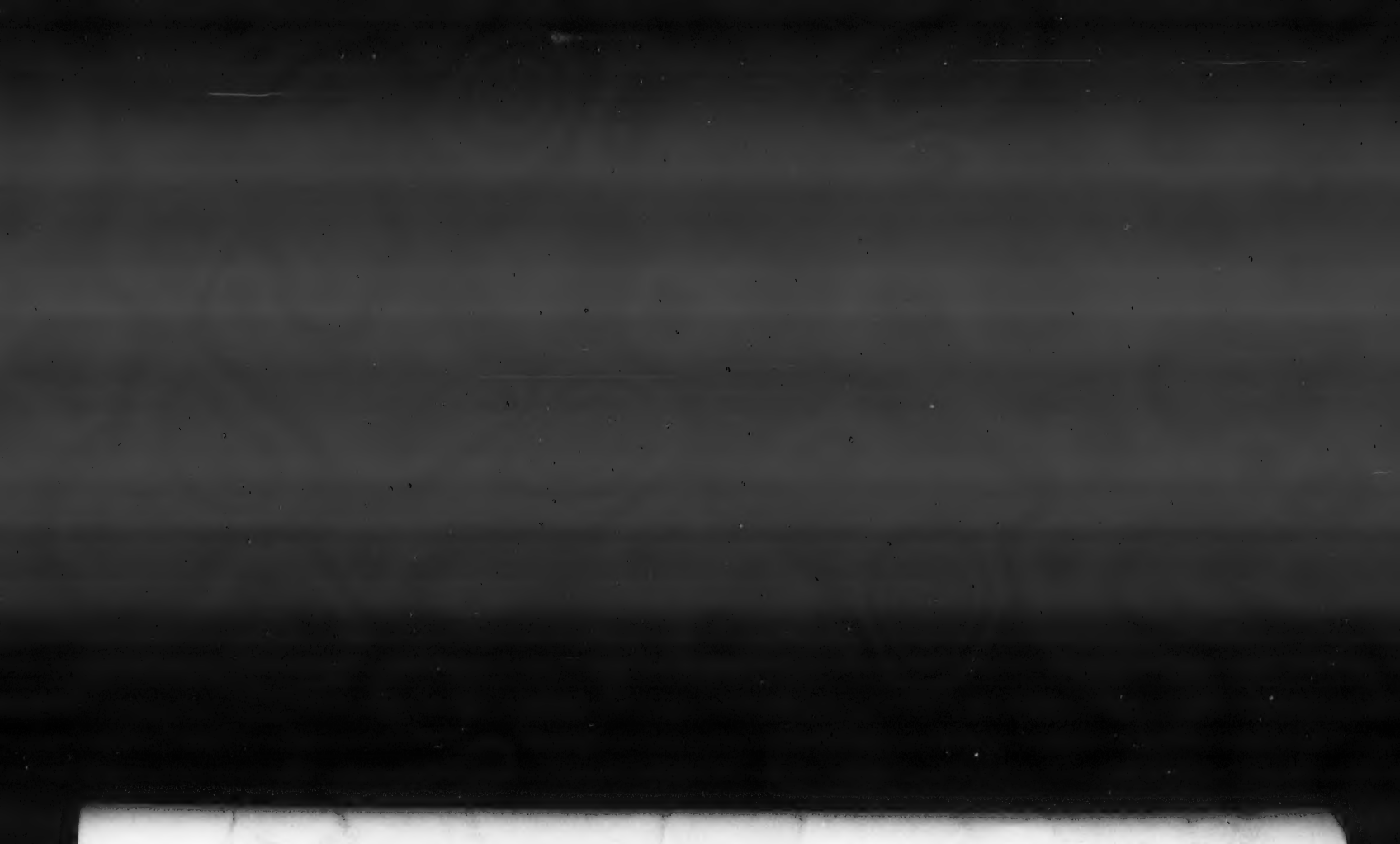
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